VOLUME XXII JUNE, 1939 NUMBER 6

JOURNAL OF DAIRY SCIENCE

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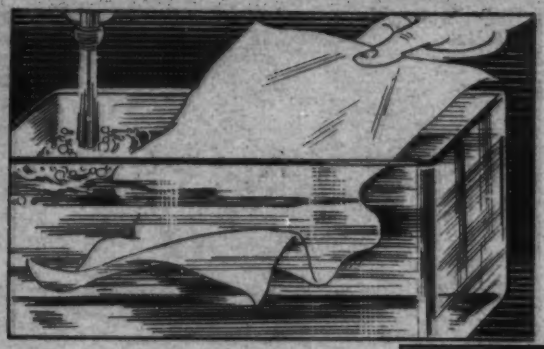

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JOURNAL OF DAIRY SCIENCE

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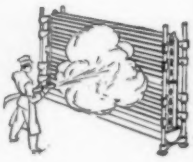
Entered as second-class matter April 13, 1934 at the postoffice at Lancaster, Pa., under the act of March 3, 1879.

NO WONDER THIS DAIRY CHANGED FROM STEAM TO DIVERSOL

Bacteriological Tests Prove Lower Counts on Equipment



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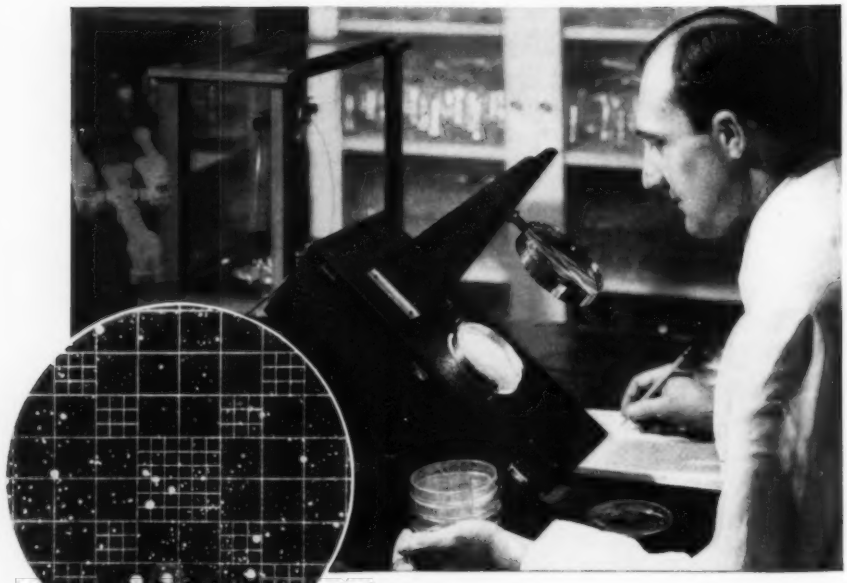

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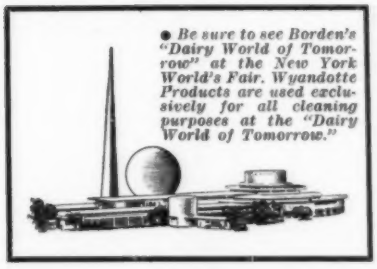
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JOURNAL OF DAIRY SCIENCE

VOLUME XXII JUNE, 1939 NUMBER 6

PROGRAM

THIRTY-FOURTH ANNUAL MEETING
THE AMERICAN DAIRY SCIENCE ASSOCIATION

STATE COLLEGE OF WASHINGTON
PULLMAN, WASHINGTON

AND

UNIVERSITY OF IDAHO
MOSCOW, IDAHO

JUNE 27–30, 1939

PROGRAM COMMITTEE

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AMERICAN DAIRY SCIENCE ASSOCIATION

The Thirty-Fourth Annual Meeting

Pullman, Washington and Moscow, Idaho

June 27–30, 1939

GENERAL PROGRAM

Monday, June 26

1:30 P. M.–5:00 P. M	General Registration and Room Registration, Davis S. Troy Hall, Pullman, Washington, or Willis Sweet Hall, Moscow, Idaho.
8:00 P. M.	Board of Directors meeting, Troy Hall, Pullman, Washington.

Tuesday, June 27

8:00 A. M.–12:00 NOON	General Registration and Room Registration, David S. Troy Hall, Pullman, Washington, or Willis Sweet Hall, Moscow, Idaho.
9:30 A. M.–12:00 NOON	MANUFACTURING SECTION. Dairy Products Judging Conference for coaches and instructors, Room 114, Troy Hall, Pullman, Washington. Scoring practice for ice cream and cheese.
1:30 P. M.–3:30 P. M.	OPENING SESSION. Auditorium, Administration Building, University of Idaho, Moscow, Idaho, Earl Weaver, Presiding. General Session. Addresses of Welcome by H. C. Dale, President, University of Idaho, and E. O. Holland, President, State College of Washington. Response and President's address by Earl Weaver, President, American Dairy Science Association. Introduction of past presidents, officers and directors of the American Dairy Science Association. Objectives of Dairy Husbandry Teaching in Secondary Schools. H. E. Lattig, Assistant Dean of Agriculture, University of Idaho. Adult Education in Dairy Husbandry. E. V. Ellington, Vice Dean and Director, College of Agriculture and Experiment Station, State College of Washington.
3:30 P. M.	Committee meetings. University of Idaho. Rooms to be assigned at registration office.
8:00 P. M.	SOCIAL HOUR. Women's Gymnasium, State College of Washington.

Wednesday, June 28

8:30 A. M.–9:30 A. M.	COMMITTEE MEETINGS. University of Idaho. Rooms to be assigned at registration office.

Inspection of extension exhibits. Room 101 and 113, Wilson Hall, State College of Washington.

9:30 A. M.–12:00 NOON — SECTIONAL MEETINGS.
Manufacturing Section, Science Hall, Room 110, University of Idaho.
Production Section, U. C. B. Room 101, University of Idaho.
Extension Section, U. C. B. Room 102, University of Idaho.

12:00 NOON — COMPLIMENTARY LUNCHEON FOR MEMBERS—Student Union Building, University of Idaho.

1:30 P. M.–3:30 P. M. — SECTIONAL MEETINGS. University of Idaho.
Manufacturing Section, Science Hall, Room 110, University of Idaho.
Production Section, U. C. B. Room 101, University of Idaho.
Extension Section, U. C. B. Room 102, University of Idaho.

3:30 P. M. — COMMITTEE MEETINGS. Rooms to be assigned at registration office.

8:00 P. M. — ANNUAL ASSOCIATION RECEPTION. Willis Sweet Hall, University of Idaho.

Thursday, June 29

8:30 A. M.–9:30 A. M. — COMMITTEE MEETINGS. State College of Washington. Rooms to be assigned at registration office.

9:30 A. M.–12:00 NOON — SECTIONAL MEETINGS.
Manufacturing Section, New Science Hall, Room 207, State College of Washington.
Production Section, James Wilson Hall, Room 13, State College of Washington.
Extension Section, James Wilson Hall, Room 112, State College of Washington.
Group picture at Field House, State College of Washington.
Complimentary Picnic Lunch, Field House, State College of Washington.

1:30 P. M.–3:30 P. M. — SECTIONAL MEETINGS.
Manufacturing Section, New Science Hall, Room 207, State College of Washington.
Production Section, James Wilson Hall, Room 13, State College of Washington.
Extension Section, James Wilson Hall, Room 112, State College of Washington.

3:30 P. M. — SECTIONAL BUSINESS MEETINGS. Same rooms as sectional meetings above.

6:30 P. M. — ANNUAL ASSOCIATION BANQUET. Washington Hotel, Pullman, Washington.
Presentation of Borden Awards.

Friday, June 30

8:30 A. M.–9:30 A. M. SECTIONAL BUSINESS MEETINGS.
Manufacturing Section, New Science Hall, Room 207, State College of Washington.
Production Section, James Wilson Hall, Room 13, State College of Washington.
Extension Section, James Wilson Hall, Room 112, State College of Washington.

9:30 A. M.–12:00 NOON GENERAL SESSION, Earl Weaver, Presiding.
Room 207, New Science Hall, State College of Washington.
Reports to the general meeting of Board of Directors, of Sections, and General Association Committees for discussion and action.

SECTION PROGRAMS

MANUFACTURING SECTION

Tuesday A. M., June 27, 9:30–12:00
Room 114, David S. Troy Hall,
State College of Washington

Dairy Products Judging Conference for Coaches and Instructors
Scoring practice for cheese and ice cream

H. A. Bendixen and D. R. Theophilus, in charge.

Wednesday A. M., June 28, 9:30–12:00
Science Hall 110
University of Idaho

P. A. DOWNS, *Chairman*

Market Milk

M1—The use of sodium metaphosphate for the preparation of soft-curd milk. Charles Schwartz, K. K. Jones, T. W. Mack, and R. W. Vance, Hall Laboratories, Inc. and Northwestern University Medical School.

M2—Effect of certain sodium salts upon the curd tension of milk. P. H. Tracy and W. J. Corbett, University of Illinois.

M3—Further studies of "curd surface" in relation to the digestibility of milk. Leslie A. Chambers, Irving J. Wolman and A. P. Hands, University of Pennsylvania.

M4—Photochemical study of the irradiation process of producing vitamin D in milk. M. J. Doreas, National Carbon Co., Inc., Cleveland, Ohio.

M5—Effect of concentrating milk in the vacuum pan on the development of oxidized flavors. W. J. Corbett and P. H. Tracy, University of Illinois.

M6—Rates of corrosion in milk of certain "white-metal" copper alloys and their influence on the flavor of milk. C. L. Roadhouse and J. L. Henderson, University of California.

M7—The rate of destruction of vitamin C in milk as an index of the solubility of copper from copper-nickel alloys. J. L. Henderson and C. L. Roadhouse, University of California.

M8—The effect of winter and summer rations, and cod-liver oil on the oxidized flavors and vitamin C in milk. E. S. Guthrie, Cornell University.

M9—Studies in rancid milk. Relation of surface tension of rancid milk to its acid coagulation. N. P. Tarassuk and F. R. Smith, University of California.

M10—A study of some factors affecting the viscosity of market cream. F. M. Skelton and H. B. Ellenberger, Vermont Agricultural Experiment Station.

PRODUCTION SECTION

Wednesday A. M., June 28, 9:30–12:00
U. C. B., Room 101
University of Idaho

H. W. CAVE, *Chairman*

Milk Secretion and Physiology and Udder Diseases

P1—The lactation-promoting properties of proteins as measured with rats. J. R. Haag and L. D. Wright, Oregon Agricultural Experiment Station.

P2—Recent advances in the endocrinology of milk secretion. C. W. Turner, Missouri Agricultural Experiment Station.

P3—Some factors affecting the reliability of arterio-venus differences in a study of blood precursors of milk. W. E. Petersen and W. L. Boyd, University of Minnesota.

P4—The respiratory quotients of the intact and perfused mammary glands of cows. J. C. Shaw, University of Minnesota.

P5—Perfusion of the excised mammary gland as a method of studying milk secretion. W. E. Petersen, J. C. Shaw, and M. B. Visscher, University of Minnesota.

P6—The effect of ultraviolet radiation on milk production. W. E. Krauss, C. F. Monroe, C. C. Hayden, and B. H. Edgington, Ohio Agricultural Experiment Station.

P7—Studies on milk and fat production of dairy cows and goats as influenced by thyroxine. N. P. Ralston, C. W. Turner and A. C. Ragsdale, University of Missouri.

P8—Two methods of feeding soybean fat to cows and their effect on milk and butterfat production and on the nature of the butterfat. Kenneth Williams, C. Y. Cannon and Dwight Espe, Iowa State College.

P9—The effect of sulfanilamide therapy upon the catalase activity of the blood and milk. A preliminary report. P. G. Miller and G. W. Anderson, South Carolina Agricultural Experiment Station.

P10—The effect of ultraviolet radiation of cows on their agglutinin titer for Bangs disease. B. H. Edgington, W. E. Krauss, C. F. Monroe and C. C. Hayden, Ohio Agricultural Experiment Station.

P11—A new routine extending the usefulness of the Hotis test for mastitis. J. Frank Cone, Bureau of Dairy Industry, U.S.D.A.

P12—The classification of the streptococci of bovine mastitis. R. B. Little, The Rockefeller Institute for Medical Research, Princeton, N. J. and F. C. Minett, Royal Veterinary College, Camden Town, London.

EXTENSION SECTION

Wednesday, A. M., June 28, 9:30–12:00
U. C. B., Room 102
University of Idaho
S. J. BROWNELL, *Chairman*

E1—Community dairy cattle breeding plans. Sire Committee, J. F. Kendrick, U. S. Bureau of Dairy Industry, *Chairman*.

E2—Bull studs in the community dairy cattle breeding program. Ivan H. Loughary, University of Idaho.

E3—Extension Farm-Security Administration bull associations in Utah. Lyman H. Rich, Utah State College.

E4—The progress and prospects of organized artificial insemination of dairy cattle. E. J. Perry, New Jersey College of Agriculture.

E5—Utilization of proved sire records and herd analysis data. Sire Committee, J. F. Kendrick, U. S. Bureau of Dairy Industry.

E6—Utilization on State and County basis. Warren Gifford, University of Missouri.

E7—Utilization in the individual dairy herd. C. F. Rowe, University of Arizona.

E8—The influence of disease in dairy cattle breeding programs. George E. Taylor, New Jersey Agricultural College.

MANUFACTURING SECTION

Wednesday P. M., June 28, 1:30–3:30
Science Hall, Room 110
University of Idaho
P. A. DOWNS, *Chairman*

Ice Cream

M11—A comparative evaluation of an ice cream supply as it reaches the consumer. L. K. Crowe and P. A. Downs, University of Nebraska.

M12—Measuring the quality of ice cream. W. H. Martin, F. E. Nelson and W. J. Caulfield, Kansas Agricultural Experiment Station.

M13—Consumer preference for individual chocolate varieties. P. S. Lucas and I. A. Gould, Michigan State College.

M14—The use of the petrographic microscope in studying the different types of lactose crystals as they occur in sandy ice cream. W. S. Arbuckle, C. W. Decker and W. H. E. Reid, Missouri Agricultural Experiment Station.

M15—The use of motion pictures in studying the influence of several factors upon the stability of ice cream and sherbets. W. H. E. Reid, W. S. Arbuckle and C. W. Decker, Missouri Agricultural Experiment Station.

M16—Microscopic technique for studying fat globules in dairy products and other oil in water emulsions. W. C. Cole, University of California.

M17—The effect of the new standard agar on the plate counts of dairy products. F. E. Nelson, Kansas State College.

M18—The development on new standard milk agar of certain organisms of importance to the dairy industry. V. D. Foltz and F. E. Nelson, Kansas Agricultural Experiment Station.

M19—Regulatory legislation and its relationship to research in manufactured dairy products. Charles S. Trimble, U. S. Bureau of Dairy Industry.

PRODUCTION SECTION

Wednesday P. M., June 28, 1:30–3:30
U. C. B., Room 101
University of Idaho

A. H. KUHLMAN, *Chairman*

P13—Results of a long time feeding experiment on bone meal vs. no bone meal in dairy ration consisting of timothy hay, corn silage, and concentrates. S. I. Bechdel, P. S. Williams, A. A. Borland, and J. F. Shigley, Pennsylvania State College.

P14—Making and feeding air dried hay to dairy heifers. C. E. Wylie and S. A. Hinton, University of Tennessee; J. W. Weaver, Tennessee Valley Authority.

P15—The nutritive value of an alfalfa hay ration compared with a mixed grass and legume hay and grass silage ration for dairy cattle. R. E. Hodgson, J. C. Knott, State College of Washington and Bureau of Dairy Industry.

P16—Studies with alfalfa hay for milk production. I. R. Jones and J. R. Haag, Oregon Agricultural Experiment Station.

P17—Comparative yields of Louisiana feed and pasture crops. R. H. Lush, Louisiana Agricultural Experiment Station.

P18—Pasture yields as measured by clip plots and by grazing dairy cows. P. M. Brandt and H. P. Ewalt, Oregon Agricultural Experiment Station.

P19—The chemical composition and nutrient yield of pasture grass grazed at successive intervals during the season. R. E. Hodgson and J. C. Knott, Bureau of Dairy Industry and State College of Washington.

P20—Some relations of the roughage intake to the composition of milk. E. B. Powell, Ralston Purina Company, St. Louis, Missouri.

P21—The influence of certain rations and management practices on the rate of growth and production of Holstein-Friesian heifers. H. A. Herman and A. C. Ragsdale, University of Missouri.

EXTENSION SECTION

Wednesday P. M., June 28, 1:30–4:30
U. C. B., Room 102
University of Idaho

S. J. BROWNELL, *Chairman*

E9—Should we unify the extension program? C. L. Blackman, Ohio State University.

E10—Michigan dairy planning activities. A. C. Baltzer, Michigan State College.

Extension Exhibits, Rooms 101 and 113
Wilson Hall, State College of Washington
Exhibits Committee Report. E. G. Scheidenhelm, Michigan State College. (Inspection and discussion of exhibits.)

MANUFACTURING SECTION

Thursday A. M., June 29, 9:30–12:00
New Science Hall, Room 207
State College of Washington
P. A. DOWNS, *Chairman*

Butter

M20—Studies with the rollerless churn. W. B. Combs and S. T. Coulter, University of Minnesota.

M21—The effect of the ration on butter fat constants. A. H. Kuhlman and W. D. Gallup, Oklahoma A. & M. College.

M22—Some observations on the iodine, Reichert-Meissl and Polenske Values of milk fat produced during the winter in three sections of Oregon. R. E. Stout and G. H. Wilster, Oregon State College.

M23—A preliminary report on investigations to overcome crumbly and sticky texture in butter made during the winter in the irrigated sections of eastern and southern Oregon. G. H. Wilster, R. W. Stein and R. E. Stout, Oregon State College.

M24—Copper in butter. B. E. Horrall and W. F. Epple, Agricultural Experiment Station, Purdue University.

M25—Acid values and acid ratios as related to the keeping quality of salted butter. H. A. Bendixen, Washington Agricultural Experiment Station.

M26—The influence of various factors on the reliability of the room temperature holding test for butter quality. D. H. Jacobsen, South Dakota Agricultural Experiment Station.

M27—Laboratory equipment for high temperature pasteurization studies. T. S. Coulter and W. B. Combs, University of Minnesota.

M28—Correlation between grades on scores and grades on criticisms in the judging of dairy products. G. M. Trout, Michigan State College.

PRODUCTION SECTION

Thursday A. M., June 29, 9:30–12:00
Room 13, Wilson Hall
State College of Washington
I. W. RUPEL, *Chairman*

Nutrition

P22—Vitamin A and carotene in relation to growth and well being of heifers. R. E. Ward and S. I. Bechdel, Pennsylvania State College.

P23—Carotene changes in natural cured, artificially dried and ensiled roughages. O. M. Camburn, H. B. Ellenberger, and G. C. Crooks, Vermont Agricultural Experiment Station.

P24—Some effects of feeding vitamin A and carotene to cows, on the composition of their milk and blood. C. H. Whitnah, W. J. Peterson, H.

W. Cave and F. W. Atkeson, Kansas Agricultural Experiment Station.

P25—The effect of feeding vitamin A and carotene to cows on the flavor of their milk. H. W. Cave, W. H. Martin and G. H. Beck, Kansas Agricultural Experiment Station.

P26—Anatomical and physiological changes in the pituitary gland in vitamin A deficiency. T. S. Sutton, Ohio State University.

P27—A field study of the influence of restricted winter rations on the blood calcium, phosphorus and carotene of dairy cattle. W. H. Riddell, F. W. Atkeson, W. J. Peterson and W. W. Thompson, Kansas Agricultural Experiment Station.

P28—Rickets in calves, a regional problem. A. H. Kuhlman and W. D. Gallup, Oklahoma A. and M. College.

P29—Further studies on the vitamin D deficiency of mature dairy cows. G. C. Wallis, South Dakota Experiment Station.

P30—Vitamin E studies with male rats. A. O. Shaw, Ella Woods, and J. O. English, University of Idaho.

P31—Are urea and other simple nitrogen compounds useful in dairy cattle feeding? E. B. Hart, G. Bohstedt, H. J. Deobald, and M. I. Wegner, University of Wisconsin.

P32—The relation of the rate of disappearance of milk curd from the calf's abomasum to the apparent digestibility of its protein. H. C. Dickey, Dwight Espe and C. Y. Cannon, Iowa State College.

P33—Factors affecting the reactions of the esophageal groove of dairy calves. George H. Wise, South Carolina Agricultural Experiment Station.

EXTENSION SECTION

Thursday A. M., June 29, 9:30–12:00
Wilson Hall, 112
State College of Washington
S. J. BROWNELL, *Chairman*

E11—Testing Committee Report. Glen Vergeront, University of Wisconsin, *Chairman.*

E12—Annual D. H. I. A. state reports or summaries, their preparation and use. Roger W. Morse, Oregon State College.

E13—D. H. I. A. methods and results in California. G. E. Gordon, University of California.

E14—Feeding Committee Report. G. G. Gibson, Texas A. and M. College, *Chairman.*

E15—The analysis and use of D. H. I. A. feed records. C. G. Cushman, Clemson Agricultural College.

E16—Progress of demonstrations with grass and legume silage. D. M. Seath and James W. Linn, Kansas State College.

E17—Pasture improvement as a project in the state dairy extension program. Otto J. Hill, State College of Washington.

MANUFACTURING SECTION

Thursday P. M., June 29, 1:30–3:30
New Science Hall, Room 207
State College of Washington
P. A. DOWNS, *Chairman*

Cheese

M29—Standards for rating cheddar cheese. J. C. Marquardt, New York Agricultural Experiment Station (Geneva).

M30—Observations on the growth responses of *S. lactis* in mastitis milk. C. C. Prouty, Washington Agricultural Experiment Station.

M31—Potentiometric studies with resazurin and methylene blue in milk. C. K. Johns and R. K. Howson, Department of Agriculture, Ottawa, Canada.

M32—Lactic acid streptococci of cheese. Blythe A. Eagles and Olga Okulitch, University of British Columbia, Vancouver, Canada.

M33—Application of the smear culture technique to the examination of cheddar cheese. C. B. Lane and B. W. Hammer, Iowa State College.

M34—Relationship of fat hydrolysis to flavor development in cheddar cheese. C. B. Lane and B. W. Hammer, Iowa State College.

M35—Some factors affecting the moisture content of Swiss cheese and their effects upon quality and yield. George P. Sanders and Robert R. Farrar, U. S. Bureau of Dairy Industry.

M36—Further studies on the gas requirements of three strains of blue mold (*Penicillium Roqueforti* group) isolated from cheese. N. S. Golding, Washington Agricultural Experiment Station.

M37—The lipolytic and proteolytic activities of various penicillia of importance in the ripening of Blue Cheese. C. Jensen, North Dakota Agricultural Experiment Station.

PRODUCTION SECTION

Thursday P. M., June 29, 1:30–3:30
Room 13, Wilson Hall
State College of Washington

H. W. CAVE, *Chairman*

P34—Artificial insemination of dairy cows. H. A. Herman and A. C. Ragsdale, University of Missouri.

P35—The inheritance of the condition for a white head in Holstein-Friesian cattle. Lester O. Gilmore, Wm. E. Petersen and J. B. Fitch, University of Minnesota.

P36—The inheritance of fertility in dairy cattle. Arless Spielman and I. R. Jones, Oregon State College.

P37—Analyses of dairy herd breeding records. S. W. Mead and W. M. Regan, University of California.

P38—Increasing production in institutional herds. A. L. Beam, C. S. McLearen and A. A. Borland, Pennsylvania State College.

P39—The use of various oils and fats for calf feeding. T. W. Gullickson and F. C. Fountaine, University of Minnesota.

P40—The influence of fineness of grinding on the digestion coefficients of oats for dairy cows. G. C. Wallis, T. M. Olson and T. A. Evans, South Dakota Agricultural Experiment Station.

P41—The effect of changes in environmental temperature on water consumption of producing dairy cows. W. M. Regan and S. W. Mead, University of California.

EXTENSION SECTION

Thursday P. M., June 29, 1:30–3:30
Wilson Hall, 112
State College of Washington
S. J. BROWNELL, *Chairman*

E18—Report of Quality Improvement Committee. C. J. Babcock, U. S. Bureau of Dairy Industry, *Chairman.*

E19—Growth of Pennsylvania 4-H Club Calves. J. C. Nageotte, Pennsylvania State College.

E20—The contribution of 4-H Dairy Clubs to the general dairy extension program. J. O. Tretsven, Montana State College.

E21—Report of Type Classification Committee. A. C. Baltzer, Michigan State College, *Chairman.*

ABSTRACTS OF PAPERS PRESENTED AT ANNUAL MEETING

MANUFACTURING SECTION

M1. The Use of Sodium Metaphosphate for the Preparation of Soft-curd Milk. CHARLES SCHWARTZ, K. K. JONES, T. W. MACK, AND R. W. VANCE, Hall Laboratories, Inc., and Northwestern University Medical School Department of Physiology and Pharmacology.

The fact that glassy sodium metaphosphate reacts with calcium salts in aqueous solution so as to form a highly soluble, stable complex, from which the calcium cannot be precipitated by the usual reagents, has led to widespread industrial use of this heretofore unusual compound. Its characteristic property encouraged an inquiry into the possibility of using it as a means of preparing soft-curd milk.

A comprehensive investigation showed that the addition of an average of 0.04 gm. of sodium metaphosphate to 100 ml. of milk, either raw or pasteurized, was sufficient to yield a product forming no curd under the usual conditions of test. Somewhat greater quantities of metaphosphate, about 0.075 gm. for each 100 ml. of milk, were required to maintain a curd-free milk through a heating process. This may be attributed to a slight reversion of the metaphosphate to orthophosphate under the influence of heat.

By increasing the amount of metaphosphate, additional calcium could be incorporated in milk and zero curd tension maintained. The amount of metaphosphate required to soften milk in the presence of added calcium was roughly 4.8 times as much as the calcium added plus an amount necessary to soften the milk itself.

Digestion experiments "in vitro" and "in vivo" on rats and dogs indicated that the metaphosphate-softened milk is more efficiently digested than the untreated milk.

The preparation of soft-curd milk with metaphosphate is easily carried out, requires no special or new equipment, and in the amounts used affects neither the taste nor appearance of the milk.

M2. Effect of Certain Sodium Salts Upon the Curd Tension of Milk. P. H. TRACY AND W. J. CORBETT, University of Illinois.

The addition of sodium citrate, tetra sodium pyrophosphate and sodium alginate have been found to lower the curd tension of milk. Sodium citrate and tetra sodium pyrophosphate are the most effective in this respect. By the addition of 0.15% tetra sodium pyrophosphate or 0.20% sodium citrate it was possible to lower the curd tension to 0, using the tentative standard method of the American Dairy Science Association. The reduction in curd

tension was greater when the salts were added to the cold milk after pasteurization than when added before heating. A noticeable but not objectionable salty flavor results from the addition of the above indicated amounts of the sodium salts. It is thought that this method of producing soft curd milk may prove particularly useful for the small milk distributor limited in plant facilities.

M3. Further Studies of "Curd Surface" in Relation to the Digestibility of Milk. LESLIE A. CHAMBERS, IRVING J. WOLMAN, AND A. P. HANDS, Eldridge Reeves Johnson Foundation and the Department of Pediatrics, University of Pennsylvania.

The apparatus and technique for estimation of "curd surface" described in a previous communication, have been modified with three principal objects in view:

1. To provide greater reproducibility of individual measurements.
2. To make the test practicable for routine examination of milk and its modifications.
3. To make the conditions under which the coagulations are carried out approximate, as closely as possible, those encountered in the normal infant's stomach.

The modified procedure involves coagulation of the milk sample at pH 4.8. While the exact value was finally selected for pragmatic reasons, it lies in a range (4.5–5.5) indicated by measurements of pH of stomach contents, and by analysis of extensive published data. pH values lower than 4.5 permit more or less proteolysis which interferes with the measurement. The surface numbers depend on the final pH of the mixture and are not dependent on the rate at which the coagulant is added. Comparison of surface numbers derived from two different types of milk at pH values from 6.5 to 4.0 shows that the ratio of total surfaces is essentially constant over the entire range although there is a progressive increase in number with increase in acid concentration. This being true there seems no valid reason for coagulating the test samples at any other pH level than that encountered in the infant stomach.

Since the value of any *in vitro* test of digestibility can be determined only by correlation with actual feeding experience, we have fed a group of infants over a period of more than a year under carefully controlled conditions on milk indicated by the "surface number test" to be theoretically as digestible as milk boiled five minutes. Without exception this trial has been successful. We therefore believe that the curd surface area is an adequate index of the relative digestibility of milk in the infant's stomach. The results also demonstrate that at least one commercially processed milk (sonic homogenized) is improved in digestibility by the processing to such an extent that it can be fed without further modification to premature and new-born infants.

M4. Photochemical Study of the Irradiation Process of Producing Vitamin D in Milk. M. J. Dorcas, National Carbon Company, Inc., Cleveland, Ohio.

This paper will discuss the consideration of the mechanics of irradiating milk from the standpoint of the Grotthuss-Draper theory of photochemistry. This theory states that only the light absorbed by the reactants can be photochemically active. In milk irradiation ultra violet produced by alternating current sources may be intermittent in character, for instance the light may be generated and extinguished 120 times a second on the common 60 cycle current. Activatable sterols may be optically shielded during these brief periods of light emission. A light source operating on three electrical phases has been developed to test this theory. This type of light source emits light continuously. When applied to the irradiation of milk it is found to give higher Vitamin D potencies than previously were commercially obtainable.

M5. Effect of Concentrating Milk in the Vacuum Pan on the Development of Oxidized Flavors. W. J. Corbett and P. H. Tracy, University of Illinois.

Condensing milk under vacuum to a concentration of 2–1 was found to retard the development of oxidized flavors. Three parts per million of copper was added before or after condensing. Condensed whole milk diluted back to normal concentration with water or the distillate collected did not develop the flavor on addition of three parts per million of copper.

It was also observed that condensed milk diluted back to its original concentration had a curd tension of approximately a half of the original milk as determined by the Hill curd test. Other cases of a correlation between curd tension reduction and lessened tendencies toward oxidation flavors have been observed; for example, homogenization, agitation, addition of certain enzymes, high heat treatment, and addition of sodium salts. The problem of oxidized flavors in dairy products is being studied from this angle.

M6. Rates of Corrosion in Milk of Certain "White-Metal" Copper Alloys and Their Influence on the Flavor of Milk. C. L. Roadhouse and J. L. Henderson, University of California.

Copper-nickel alloys have been used in the dairy industry for many years and those previously studied have been found to cause oxidized flavor in milk.

The modern trend has been to use corrosion-resistant metals in dairy equipment to avoid as far as possible the development of the oxidized flavor in diary products. Technical difficulties have been encountered in the fabrication from stainless steel of certain dairy equipment, such as fittings, valves and bearings.

A comparison was made of the corrosion of certain copper-nickel alloys in milk during the pasteurization process. The procedure used for study-

ing the rates of corrosion was that previously described.[1] The alloys studied contained from 62 to 66.5 per cent copper and from 20 to 31 per cent nickel with smaller amounts of tin, lead, zinc, chromium, iron and manganese added to some of them.

The results show that when 3 to 8 per cent of tin and 3 to 4 per cent of zinc are included in the composition of copper-nickel alloys, the corrosion rates in milk are reduced and the development of oxidized flavor is delayed.

The data appear to indicate that tin and zinc, when included in the composition of the copper-nickel alloys, inhibit the solubility of the copper by milk.

Several samples showing differences in solubility of copper were polished, etched, and photomicrographed in an attempt to correlate the resistance to attack with the presence of secondary phases in the grain structure.

M7. The Rate of Destruction of Vitamin C in Milk as an Index of the Solubility of Copper from Copper-Nickel Alloys. J. L. HENDERSON AND C. L. ROADHOUSE, University of California.

A common method for determining the rate of corrosion of metals by milk is to agitate the metals in milk during the pasteurizing process and determine the weight losses. The results of such determinations, in which a total of twenty copper-nickel alloys were tested, showed that this amount of exposure of the alloys to milk, in most cases caused sufficient solution of copper to develop oxidized flavor, except in the least susceptible milks. Milks so treated showed that most of the vitamin C was destroyed during pasteurization.

Since copper-nickel alloys are often used for fittings and valves, cast alloys were exposed to milk for brief periods to simulate commercial operation. The extent of vitamin C destruction when compared to that of control samples of the same milk, was used to indicate the amount of copper contamination. Copper, in the presence of oxygen, is a specific catalyst for the oxidation of vitamin C. The other important elements in the alloys, *i.e.*, zinc, lead and nickel, were found not to influence the rate of destruction of vitamin C.

The milks used were produced in such a manner that exposure to sunlight and metal contamination were avoided. Vitamin C was determined by titration of trichloracetic acid-metaphosphoric acid serum with sodium 2–6 dichloro-benzenone idophenol.

Minute amounts of copper in solution, such as resulted from dipping the copper alloys into milk 10, 20 and 100 times, could be detected from the rate of destruction of vitamin C. This method may be used to evaluate the copper contamination of milk by copper containing alloys exposed to milk for various periods at different temperatures.

[1] Hilgardia *5*, 225–253, 1931.

M8. The Effect of Winter and Summer Rations, and Cod-Liver Oil on the Oxidized Flavors and Vitamin C in Milk. E. S. GUTHRIE, Cornell University.

The studies on the winter and summer rations extended over a period of one year and in most cases from one lactation period to another. The cows were fed the usual grains and hays as well as silage. Twelve cows from one herd receiving only corn silage, along with the usual amounts of grains and hays, were in the experiment and nine cows from another herd of Cornell University were studied. These cows received molasses-hay silage, phosphoric-acid-hay silage, and corn silage as a part of their roughage.

The pasteurized samples of milk were scored on the third and seventh days. The results were recorded in the same way as the oxidized flavors have been reported by a number of investigators. Vitamin C was determined by titration according to Sharp.

The four cows on the cod-liver oil experiment were fed by drenching, up to 400 ml. at a single feeding once each day.

SUMMARY

1. There was little difference in the oxidized flavors in the milk between the winter and the summer feedings. When the milk was three days old the oxidized score in the summer was .99 and in the winter it was .76. The seven-day reading was 1.45 and 1.49 respectively.

2. The grand averages of the milligrams per liter of reduced vitamin C in the fresh milk was practically the same, for the summer analyses showed a figure of 22.19, and the winter data were 22.21.

3. The milks of all four of the cows that were fed cod-liver oil were free from the oxidized and other off flavors at the beginning of the study. As the experiment progressed the fresh milk lost its characteristic flavors, and on standing a goaty flavor appeared in the milk of cows number 1, 2, and 3, while the milk from cow number 4 became very oxidized.

4. The following figures show the increases in reduced vitamin C in the milk from the check level when no cod-liver oil was fed, to the average of the three high readings when the amount of the oil fed was at high level: Cow No. 1, 111 per cent; cow No. 2, 31.3 per cent; cow No. 3, 48.1 per cent; and cow No. 4, 38.3 per cent.

M9. Studies on Rancid Milk. Relation of Surface Tension of Rancid Milk to Its Acid Coagulation. N. P. TARASSUK AND F. R. SMITH, University of California.

The partial inhibition of the growth of bacteria in rancid milk, particularly that of *Streptococcus lactis* with resultant delayed and abnormal (absence of regular firm clot) acid coagulation of milk has been reported by

Koestler, Roadhouse and Lörtscher (1928). The above authors gave no explanation for this phenomenon observed by them.

The data from the studies of Tarassuk and Palmer, Palmer and Tarassuk (in press), on physical and chemical properties of the adsorption "membrane" around the fat globules in cream indicated definitely that rancid milk must have significantly lower surface tension than that of non-rancid milk.

In the present studies on natural rancid milk it has been found that within certain limits there is a direct relationship between degree of rancidity of milk and its surface tension. As the hydrolytic rancidity develops the surface tension of milk decreases gradually from normal value of 50–52 dynes to 37–38 dynes. In fact, in our opinion the change in surface tension is the most profound change that differentiates the rancid milk from non-rancid milk and it has been used by one of us as a tool for general study of lipolytic activity of milk in preference to other methods hitherto employed for that purpose. The lowering of surface tension is due of course to fatty acids set free by hydrolysis.

The evidence was obtained that the phenomenon of delayed acid coagulation of rancid milk is due entirely to its comparatively low surface tension. When surface tension of milk is lowered by other means than the development of hydrolytic rancidity, such as by the addition of diglycol laurate or certain fatty acids, a similar phenomenon takes place. It is well known that surface tension is an important factor in growth of organisms and the surface tension of media in the neighborhood of 35 dynes is a critical one for the growth of *Streptococcus lactis*.

All samples of non-sterilized and sterilized rancid milk inoculated with *Streptococcus lactis* have shown the delayed growth. The important feature brought out in this connection is that when sterilized rancid milk is inoculated with *Streptococcus lactis* and set at optimum temperature, there is a somewhat longer than normal lag period. Furthermore, the growth during the logarithmic growth period is considerably slower (much longer generation time) than that of the normal milk. A further important point is that when the organisms begin to increase by an appreciable amount, an increase in surface tension is also apparent. When acid fermentation reaches the coagulation stage the surface tension of such milk approaches the surface tension value of normal milk. This increase in surface tension takes place also in a smaller degree on the inoculation of not sterilized rancid milk with *Streptococcus lactis*. The experimental data obtained suggest that the increase in surface tension is due to the utilization of free fatty acids by *Streptococcus lactis* in the process of growth.

M10. A Study of Some Factors Affecting the Viscosity of Market Cream.
F. M. Skelton and H. B. Ellenberger, Vermont Agricultural Experiment Station.

A study of the factors affecting the body of market cream, conducted at this station during the past two years, has shown that cream viscosity can be increased or decreased by simple heat treatments with no microscopic evidence of changes in fat globule clumping. This fact tends to minimize the importance hitherto placed upon fat globule clumping as a major factor influencing cream viscosity.

In an attempt to explain the decrease in viscosity after pasteurization and the increase following a subsequent heat treatment, the following procedure was used:

Samples of 30 per cent raw, pasteurized and heat treated cream from the same lot were centrifuged in an International clinical centrifuge at 1800 r.p.m.'s for three hours at a temperature of 40° F. ± 5°, using 15 ml. separatory tubes. The amount of skimmilk was read directly in ml. from the graduated separatory tube. The skimmilk was then drawn off and analyzed for total solids, fat, and solids-not-fat by the Mojonnier method.

In all cases the greatest amount of skimmilk was obtained from the pasteurized cream, usually from 2 to 3 ml. more than from either the raw or heat treated cream. There was little difference in the amount obtained from the raw and heat treated cream, the latter tending to be a little lower than the former. This last relationship, however, varied somewhat from week to week. The differences in the amount of skimmilk obtained may justifiably be interpreted to mean that pasteurization decreases and heat treatment increases the amount of bound water in cream. This is in agreement with work on bound water, reported by Dahle and Pyenson.

Analyses in most cases showed both the percentage and amount of S.N.F. to be the lowest in the skimmilk from heat treated cream and significantly higher in the skimmilk from the pasteurized and raw cream, the latter being slightly the lower of the two. These results, along with the difference in the extent of packing of the fat globules as indicated by the difference in amount of skimmilk obtained tends to indicate that pasteurization reduces, and heat treatment increases the adsorption of plasma colloids on the fat globule membrane.

M11. A Comparative Evaluation of an Ice Cream Supply as It Reaches the Consumer. L. K. Crowe and P. A. Downs, University of Nebraska.

A study has been made of factory filled and fountain dipped pint packages of vanilla ice cream as available to the consumer in a municipality of 80,000 population. Thirty-seven pint samples from nineteen manufacturing sources are included.

The study includes a comparison of these samples on the basis of cost, net weight, calculated overrun, total solids, butterfat, protein, carbohydrate (calculated), calories (calculated), pH, total bacteria count, *B. coli*, flavor score

and body score. The samples are compared as purchased and after adjustment to a standard price basis.

M12. Measuring the Quality of Ice Cream. W. H. MARTIN, F. E. NELSON, AND W. J. CAULFIELD, Kansas Agricultural Experiment Station.

During the summer of 1938 pint or quart samples of vanilla ice cream were collected from 318 manufacturers by the dairy division inspectors of the Kansas State Board of Agriculture. These samples represented most of the ice cream manufactured in the state. The standard plate count, the determination of *Escherichia-Aerobacter* organisms using brilliant green lactose peptone bile broth, Scharer's rapid phosphatase test, the Minnesota butterfat test and the determination of the weight per gallon were made on each sample. Each sample was scored for flavor, texture, color and package.

Plate counts of 100,000 or less per ml. were obtained on 56.2 per cent of the samples, and 17.3 per cent of the samples had counts below 10,000 per ml. Little difference was noted between the counts on samples from wholesale manufacturers and from counter freezer operators. Only 13.7 per cent of the ice creams contained no *Escherichia-Aerobacter* organisms in 1 ml. quantities, and 21.5 per cent contained these organisms in 0.001 ml. quantities. Some correlation was noted between numbers of *Escherichia-Aerobacter* organisms and total plate counts.

The phosphatase test was of little value unless controls were run on all "positive" tests to determine whether the result was due to the presence of the phosphatase enzyme or to materials added to the ice cream. Of the 143 samples giving "positive" phosphatase tests only 17 were true positives, the other 126 being positive because of interfering substances present. The 17 samples which gave true positive phosphatase tests showed a marked tendency to be high in total plate count and in number of *Escherichia-Aerobacter* organisms and low in score.

The butterfat tests indicated that most manufacturers were complying with the legal standard for ice cream. The range of weight in pounds per gallon indicated that many samples of ice cream were high in overrun, and this adversely affected the quality of the product.

Correlations between some of the various tests were frequently observed, but no one test could be relied upon to give a satisfactory evaluation of the quality of a given ice cream sample.

M13. Consumer Preference for Individual Chocolate Varieties. P. S. LUCAS AND I. A. GOULD, Michigan State College.

No literature exists on the distinctive qualities the use of unblended varieties of chocolate may add to ice cream although characteristics of cocoa beans, grown in different sections of country along the equator, have been noted in the several texts on the subject. In this study chocolate

liquor was milled without blending or flavor addition from the following beans available on the New York market: F. F. Accra (Africa), Superior Bahia (Brazil), strong type Sanchez (West Indies), Arriba (Ecuador), LaGuaire Caracas (Venezuela), fine type Trinidad (West Indies), and Puerto Cabello (Venezuela). These were analyzed for fat and ash content, using several methods for determination of the former.

Each was homogenized into separate mixes at the rate of two, two and a half, and three pounds per five gallons of mix. Samples were saved for scoring by experienced judges and by the public. Two hundred ninety-eight consumers scored each of the seven samples. Trinidad was preferred by most consumers; Puerto Cabello rated second; Bahia, third; Sanchez, fourth; Accra, fifth; Caracas, sixth; and Arriba, least. The weighted average scores were respectively, 4.4865, 4.4295, 4.1879, 4.1241, 3.8288, 3.7181, and 3.1879.

Determinations of pH were nearly identical as were fat content. Variation in color and flavor were quite noticeable and to a greater degree than shown by the composite judgment of consumer scores.

M14. The Use of the Petrographic Microscope in Studying the Different Types of Lactose Crystals as They Occur in Sandy Ice Cream.*

W. S. Arbuckle, C. W. Decker and W. H. E. Reid, Missouri Agricultural Experiment Station.

A number of different types of lactose crystals varying in shape and size have been found in sandy ice cream. It seems that the optical characteristics of these crystals however have not been definitely determined. The purpose of this paper is to present the results of a preliminary investigation concerning the optical properties of the different types of "sand" crystals as determined by the use of the petrographic microscope.

"Sand" crystals were isolated from ice cream containing 15.5 per cent serum solids which had been heat shocked to promote "sand" formation. These crystals were separated from the ice cream by centrifugal force and then washed in a saturated solution of lactose and then in acetone. The optical properties including refractive indices, optical character, optical angle, interference color, cleavage and dispersion were determined on the crystals.

The alpha hydrate form of lactose was positively identified by the optical date obtained. The bata anhydrate form of lactose has been tentatively identified although a survey of the literature failed to reveal any optical data on this form of lactose.

Chemical, as well as optical observations, indicate that very little if any sucrose is present in "sand" crystals.

* Contribution from the Department of Dairy Husbandry, Missouri Agr. Exp. Sta., Journal Series No. 604.

M15. The Use of Motion Pictures in Studying the Influence of Several Factors Upon the Stability of Ice Creams and Sherbets.* W. H. E. Reid, W. S. Arbuckle and C. W. Decker, Missouri Agricultural Experiment Station.

Studies have been made in regard to the use of ordinary colors and chromatic films taken with motion picture equipment showing the relation of variable mix compositions, effects of several factors in the manufacturing procedure and subsequent treatment to which ice creams may be subjected.

This investigation has been limited to the application of motion pictures in studying the effect of several factors upon the stability of ice cream and sherbets. The ice creams and sherbets studied include those of common flavors, also fruit and nut ice creams.

The use of motion pictures permits acquisition of more complete detailed data than is obtainable when the usual procedure is followed. Availability of data so recorded emphasizes certain factors which may not otherwise be observed.

The report of this investigation will be illustrated by the use of motion pictures showing the effectiveness of this procedure.

M16. A Microscopic Technique for Studying Fat Globules in Dairy Products and Other Oil In Water Emulsions. W. C. Cole and F. R. Smith, University of California.

In certain branches of the dairy industry it is important to know the size of the dispersed fat globules. Although several methods have been proposed to aid in such observations there is usually some difficulty in clearly differentiating the fat globules from the continuous phase. The basis of the method proposed here is that it clearly differentiates the fat globules from the background in this type of emulsion by staining the fat globules red and the continuous phase blue.

Several stains were tried to see if they might be of value in distinguishing the fat globules from the rest of the emulsion. Of those used Nile blue sulfate was the most satisfactory. It has been established that commercial Nile blue consists of a blue and a red form of the dye. The blue portion is soluble in water while the red form is preferentially soluble in fat. It is also known that the red form of the dye is encouraged by an alkaline medium.

In this study it was found desirable to dissolve the dye in a solution made slightly alkaline by the addition of sodium bicarbonate. Without taking this precaution the proportion of the red form of the dye may be insufficient to properly stain the fat. The method used is briefly described as follows: (1) Dilute the material to be examined in distilled water (usu-

* Contribution from the Department of Dairy Husbandry, Missouri Agr. Exp. Sta., Journal Series No. 603.

ally 1 to 100). (2) Place approximately one-fiftieth of a cc. (two loop fulls) of this diluted material on a clean microscopic slide. (3) Add about one-hundredth of a cc. (1 loop full) of an alkaline aqueous solution of 1 per cent Nile blue sulfate and mix well with the sample on the slide. (4) Place a cover slip over the material and examine under the microscope.

This method has been successfully used for examining milk, cream, chocolate milk, ice cream mix and evaporated milk as well as for observing fat globules in certain artificial emulsions such as mayonnaise.

M17. The Effect of the New Standard Agar on the Plate Counts of Dairy Products. F. E. NELSON, Kansas State College.

The new medium for the standard plate count of dairy products which was adopted by the Committee on Standard Methods for the Examination of Dairy Products of the American Public Health Association as the official medium after July 1, 1939, was compared with the present standard agar and with tryptone-glucose-skimmilk agar to determine its influence on the results of the standard plate count. Counts were made on 38 samples of raw milk, 27 samples of pasteurized milk, 7 samples of pasteurized cream and 32 samples of ice cream, using each of the three media at both 32° and 37° C. incubation temperatures.

The logarithmically determined average ratio of the counts on the new agar to the counts on the present agar, using the 37° C. incubation temperature, was 1.360 for the raw milk samples, 1.767 for the samples of pasteurized milk and cream and 1.350 on the ice cream samples. The logarithmic average of the ratios of the counts on the new agar to the counts on tryptone-glucose-skimmilk agar was almost exactly 1.000 in each series, being 1.034 for raw milk, 1.025 for pasteurized milk and cream and 0.992 for ice cream. Significant decreases in count resulted from the use of the improved agars in a few cases, but at least small increases in count usually were observed under these conditions. The logarithmic average increase in count due to the use of 32° C. as the incubation temperature was appreciably less when the new agar was used than when the plates were poured with the present agar if pasteurized samples were plated, but no such difference occurred when unpasteurized samples were plated.

The colonies which developed on the new standard milk agar usually were considerably larger and more easily counted than those developing on the present standard milk agar, being about the same as those which develop on tryptone-glucose-skimmilk agar. Pin-point colonies were almost never encountered when using either of the improved agars, while they occurred rather commonly on the present standard milk agar.

Higher standard plate counts may be expected in most cases as a result of the substitution of the new standard milk agar for the one now in use, the increase being about equal to that which would be obtained by using

tryptone-glucose-skimmilk agar. In some cases the increase in count undoubtedly will be in excess of 300 per cent. Studies of typical organisms which fail to develop countable colonies on the present agar but are able to grow satisfactorily on the new medium are now in progress.

M18. The Development on New Standard Milk Agar of Certain Organisms of Importance to the Dairy Industry. V. D. FOLTZ AND F. E. NELSON, Kansas Agricultural Experiment Station.

Determinations were made of the comparative growth on the new standard milk agar and old standard milk agar of a series of pathogenic and non-pathogenic gram positive cocci and bacilli of possible importance in the dairy industry. Serial dilutions of saline suspensions of the organisms grown on sugar-free beef infusion agar slants were plated on the two agars. Incubation was at 37° C. for 48 hours.

Of 2 Lancefield group A streptococci (*S. scarlatinae*) both developed colonies easily distinguishable by aid of the Quebec counter on the new medium. No colony visible with a magnification of 30X developed on the old medium.

With 53 Lancefield B. (*S. mastiditis*) cultures all developed easily countable colonies on the new medium. Using the old medium 5 cultures developed colonies which could be recognized when using the Quebec colony counter. Twenty cultures gave colonies which could be recognized as such with a 10X magnification, 10 cultures necessitated the use of 30X magnification whereas 18 cultures apparently did not develop at all.

Seven Lancefield C. (animal pyogenes) streptococci grew on the new medium forming colonies which were easily countable using the Quebec counter. No growth was observed in the old medium.

On the new medium with one culture each of *S. durans, S. fecalis, S. lactis* and *S. zymogenes* easily countable colonies developed whereas no colonies countable with the Quebec colony counter developed on the old medium. Four cultures of *L. bulgaricus* failed to develop colonies on the old medium and only one of these cultures developed countable colonies on the new medium. With two cultures of *L. acidophilus,* one failed to develop detectable colonies in the old medium whereas the other culture developed small almost indistinguishable colonies. This was in contrast to very easily countable colony development in the new medium. One culture of *S. thermophilus* failed to give detectable colonies in either medium. With 5 cultures of *S. liquefaciens* the new medium developed detectable colonies in four instances. On the old medium one of these cultures did not form detectable colonies, while the other four cultures developed minute pin-point colonies which ordinarily would not be counted. Three cultures of *L. casei* failed to develop in the old medium in comparison to the development of difficultly countable colonies in two of the three strains in the new medium.

Many of the bacteria which are important in dairy products fail to develop countable colonies on the old standard milk agar, but grow well enough on the new standard milk agar to form colonies which are quite easily countable. Some of those organisms which fail to develop satisfactorily on the new medium belong to the same species as do some of those which do form countable colonies, indicating some variation among strains.

M19. Regulatory Legislation and Its Relationship to Research in Manufactured Dairy Products. CHARLES S. TRIMBLE, U. S. Bureau of Dairy Industry.

The question of the proper relationship between existing regulatory law pertaining particularly to manufactured dairy products and modern educational research is one which, because of the complex nature of modern manufacturing methods as at present used, requires or should require careful study and consideration on the part of those engaged in dairy products research. The line of demarcation between legal and illegal manufacturing processes in the light of existing regulatory law is often difficult to define; therefore it becomes more and more important for research agencies to consider the regulatory angle very carefully before undertaking any extensive research. The problems to be considered are twofold in that both research and regulatory agencies have their own separate problems to face. Regulatory laws which might be termed basic and which have been on the statute books for a long time when compared to their relationship to earlier and present day research show much room for a changed attitude on the part of all concerned. Basic research should not be restricted simply because of possible long existing legal obstacles to the use of new facts for what may be illegal today may conceivably be declared legal tomorrow. A comparison of strictly commercial research and patented processes as contrasted with basic educational research and examples of both kinds of research are described. A brief history of the background and reasons for such basic regulatory laws as oleomargarine law of 1886; filled cheese law of 1896; process or renovated butter and adulterated butter laws of 1902 and the filled milk law of 1923 are given with their present day application in so far as today's research are concerned. There should not be any conflict between basic research for new facts and existing regulatory law, neither should the research investigator advocate the manufacture of any product which regulatory agencies hold to be in direct violation of the letter or spirit of existing laws or regulations. The possible need of revision or amendment of some existing laws is briefly discussed if real progress in research is to be attained. No specific recommendations or discussion of relative merits of present day practices is attempted but the whole subject of relationship treated generally as being worthy of possibly more careful attention in the present than has been given to the question in the past.

M20. Studies with the Rollerless Churn. W. B. COMBS AND S. T. COULTER, University of Minnesota.

The rollerless churns on the market are finding favor in American creameries. The work here reported presents results secured on observing the churning efficiency of these churns as compared with a standard single roll churn. Comments are offered on the body and texture and the uniformity of the composition of butter churned and worked in the rollerless churn.

M21. The Effect of the Ration on Butter Fat Constants. A. H. KUHLMAN AND W. D. GALLUP, Oklahoma A. & M. College.

The results obtained with grade Jersey cows used in an investigation of the vitamin A requirements of dairy cattle offered an opportunity to study several factors which influence the physical and chemical properties of butter fat. These cows received a basal ration consisting of several levels of intake of prairie hay, molasses beet pulp, and cottonseed meal with bone meal as a mineral supplement. Daily allowances of 4, 8, and 11 pounds of prairie hay represent the levels of hay intake in three of the rations used with molasses beet pulp and cottonseed meal. Another ration consisted entirely of prairie hay and cottonseed meal fed *ad libitum*.

Separate churnings were made from the cream of the combined morning and evening milkings of individual cows at 30-day intervals during the entire lactation period for eight cows. For the butter fat obtained from each of these churnings, fat constants were determined for the melting point, melting time, hardness, and iodine value.

The results reveal individual variability with respect to the properties of the fat produced by cows on the same feed, and in the same period of lactation. Likewise, there were wide differences between samples from the same individual. The combination of cottonseed meal and prairie hay produced a hard butter fat with a high melting point, and slightly lowered iodine value. Butter fat produced in the early periods of lactation was usually softer, and had a lower melting point, and higher iodine value than that produced in the later periods. Molasses beet pulp when fed at the highest level was effective in decreasing butter fat hardness.

M22. Some Observations on the Iodine, Reichert-Meissl and Polenske Values of Milk Fat Produced During the Winter in Three Sections of Oregon. R. E. STOUT AND G. H. WILSTER, Oregon State College.

A comparison was made between the iodine, Reichert-Meissl and Polenske values of milk fat produced under winter feeding conditions in three agricultural areas of Oregon: the coast section where native grass, clover, vetch and

oat hays, silage, root crops and some mixed grains are fed to cows during the winter; the Willamette Valley section where clover, vetch and oat hays, some alfalfa hay, root crops, silage and some grain are fed; and the eastern and southern Oregon section where alfalfa hay forms the major portion of the winter ration. Samples of butter made during January, 1939, were obtained from 15 representative creameries for analysis.

In general, the butter obtained from the coast and Willamette Valley sections had a medium-firm body and a close texture, while that manufactured in the eastern and southern Oregon section had a firm body and showed a crumbly and sticky texture.

Very little difference was found to exist in the unsaturated fatty components of the milk fat produced in the three above sections. The iodine values of the fat from all sections ranged from 29.75 to 32.5 and averaged 31. The iodine values of the fat produced in the Willamette Valley ranged from 29.75 to 31.43 and averaged 30.55, those of fat from the coast ranged from 31.38 to 32.5 and averaged 31.89, while those of fat from Eastern and Southern Oregon ranged from 29.95 to 31.70 and averaged 30.74.

Milk fat from the coast had Reichert-Meissl values that ranged from 29.25 to 31.5 and averaged 30.65, and Polenske values that ranged from 2.09 to 2.34 and averaged 2.23. Fat from the Willamette Valley had Reichert-Meissl values that ranged from 30.78 to 31.45 and averaged 31.10, and Polenske values from 2.01 to 2.30 with an average of 2.18. Fat from Eastern and Southern Oregon had Reichert-Meissl values that ranged from 26.03 to 27.89 and averaged 27.02, and Polenske values from 1.71 to 1.85 with an average of 1.78.

M23. A Preliminary Report on Investigations to Overcome Crumbly and Sticky Texture in Butter Made During the Winter in the Irrigated Sections of Eastern and Southern Oregon. G. H. WILSTER, R. W. STEIN AND R. E. STOUT, Oregon State College.

The defect, crumbly and sticky texture of butter, affects the butter made in 34 creameries in the irrigated alfalfa producing sections of Eastern and Southern Oregon. A large percentage of the butter made in these creameries during the winter is shipped in 68 pound cubes to various markets where it is sold in competition with butter that does not possess the undesirable texture defect. This results in an unfavorable market acceptance, and the butter, when it shows the defect to a noticeable degree, is sold at a lower price.

The following are some of the results that have been obtained to date:

1. The use of cold wash water made the butter granules very hard. A much longer time was required for completing the working process. There was an increased danger of stickiness by this method, but in some instances the crumbly tendency was reduced. Under the condition of the investigation, this was not a reliable corrective method by itself.

2. When the cream was held overnight at a low temperature, such as below 48° F., after pasteurization and cooling, even though it was churned at a relatively high temperature such as from 58° to 60° F., the hardness of the butter was increased. The crumbly character became more pronounced. Higher holding temperatures resulted in softer-bodied butter, but they did not prevent stickiness or crumbliness.

3. The length of time of holding the cream after pasteurization and cooling until it was churned had an effect on the texture of the butter. Some improvement in texture was noticed when the cream was churned immediately after pasteurization and cooling or when not held longer than periods up to two hours after pasteurization and cooling. When the pasteurized, cooled cream was held from 14 to 18 hours, then heated to 120° F., cooled rapidly in a coil vat to a suitable churning temperature, and churned immediately, it resulted in butter that was relatively free from stickiness, but it showed the firm, brittle characteristic after it had been cooled to a temperature of 45° F. in a refrigerator.

4. Slow working of the butter in some cases improved the texture of the butter. This method was very slow and required up to two hours for a complete working. The butter received a much longer and less severe working, which seemed to be beneficial.

5. The rate of cooling of the cream after pasteurization had a marked effect on the butter in the churn. Rapid cooling to a low temperature (below 48° F.) caused the granules and the butter to be very firm. Rapid cooling to 70° F. and then slowly to 48° F. (about 45 minutes) caused softer granules and softer butter. Less crumbliness was noticed in the butter made from the slow-cooled cream.

6. Flash pasteurization seemed to have little effect in improving the butter texture.

7. Butter was taken from the churn and held for several days at a temperature of 40° F., 50° F. and 70° F. respectively. After holding at these temperatures, the butter was tempered over a period of two days to 50° F. and examined. The butter that had been held at 40° and 50° F. showed stickiness but little crumbliness, while the butter that had been held at 70° F. was reasonably free from stickiness but showed pronounced crumbliness.

M24. Copper in Butter. B. E. Horrall and W. F. Epple, Agricultural Experiment Station, Purdue University.

A year's study has been completed on the copper content of butter. The samples used in this study were from approximately fifty plants, manufacturing butter in Indiana and neighboring states. These samples were sent in monthly for analysis.

The copper content was determined by our modification of the Ritter method. This modification consisted of adding one-half ml. of copper-free water and eliminating the addition of milk. No incubation was necessary with this procedure. The test is as follows:

Place about 10 grams of unmelted butter in a test tube and add one-half ml. of copper-free distilled water. This mixture is heated at 90° C. for five minutes. The samples should be placed in a water bath previously

heated to 90°–91° C. and this temperature maintained throughout the holding period to kill or inactivate any peroxidase present.

Solutions (1) 0.2 gm. para-amino-dimethyl-anilin sulfate is added to 5 cc. of copper-free water (glass distilled) and heated to 90° C. in the presence of bone black (1 gm.) and then filtered. (Made fresh every day.) (2) 1% of alpha naphthol in alcohol. (3) H_2O_2 1% solution in glass distilled water.

Add to the melted butter one drop of each of the above solutions, shaking after adding the first two. Then add one drop of the H_2O_2 and shake again. Watch the separation of the curd and time the color begins to appear. In the very positive copper samples, the purple color appears almost at once. "Positive" in about five minutes and "trace" in 10–15 minutes. We have found that if the color does not develop in 15 minutes, it is normal copper content and called "negative."

This qualitative method was compared with Williams quantitative method using a neutral wedge photometer for the measurement of the developed color.

1. There was an average of 21.3 per cent of the samples showing positive copper, while 39.1 per cent showed slight copper and 39.6 per cent negative copper.

2. A keeping quality test (70° F. for seven days) was made on all of the butter and the results indicated that the positive samples had inferior keeping quality.

3. Most of the butter with positive copper was of poorer quality when received.

4. The pH of the butter interfered somewhat with the test. With most of the high pH samples (7.1–7.5) the test was unreliable. The curd was generally suspended and remained in the fat, with the result that such butter gave a negative test to the modified Ritter test even though the copper content was high.

5. The comparison of the modified Ritter test with the quantitative test (Williams) indicated that the negative copper samples ranged from 0.0 to 0.58 parts per million and averaged 0.229; the slight copper samples ranged from 0.19 to 0.54 and averaged 0.291 parts per million, while the positive copper samples ranged from 0.32 to 2.33 and averaged 0.583 parts per million.

M25. Acid Values and Acid Ratios as Related to the Keeping Quality of Salted Butter. H. A. BENDIXEN, Washington Agricultural Experiment Station.

The acid values were determined for 28 samples of butter made from sweet cream and 51 samples made from neutralized cream by titrating a boiling mixture of 10 grams of butter and 50 ml. of neutral ethyl alcohol with N/50 Na OH using phenolphthalein as an indicator. In a similar manner

the acid values were also determined for the butterfat obtained from the above samples of butter by centrifugation of the butter melted at 45° C. The acid ratios were determined by dividing the butter fat acidity by the butter acidity and multiplying by 100.

High acid values of butter and butter fat before and after storage showed a slight tendency toward reduced keeping quality of the butter at 0–5° C. High increases in the acid values after storage at 21° C. and 0–5° C. did show a fairly close correlation with reduced keeping quality of sweet cream and neutralized cream butter, at 0–5° C, but especially with sweet cream butter.

An increase in the acid ratio during one week at 21° C. and during one month at 0–5° C. seemed to be very closely related to poor keeping quality of the butter at 0–5° C., especially in the case of sweet cream butter.

M26. The Influence of Various Factors on the Reliability of the Room Temperature Holding Test for Butter Quality. D. H. JACOBSEN, S. Dakota State College.

In an effort to determine the cause of the lack of agreement between the results of the holding test at room temperature and the keeping quality at lower temperatures, a series of comparisons were made on both salted and unsalted butter. The room temperature holding tests were made by holding five ounce samples in a thermostatically controlled box at 21 ± 1° C. Similar samples of the corresponding butter were held at 4.4° C. in a laboratory refrigerator and at approximately 0° C. in a butter holding room.

The samples were examined for flavor deterioration at intervals depending on the temperature of holding. The factors considered were the salt content, the yeast and mold count and the total, lipolytic and proteolytic bacterial counts. The microbiological examinations were made both before and after holding at the various temperatures.

Seventy-eight lots of butter from South Dakota creameries have been studied. These tubs represented churnings made for the educational scoring contests held at the College over the last three years. In addition to these, thirty-six laboratory churnings have been made using cream inoculated with cultures of known lipolytic or proteolytic activity.

The results indicate that, in general, the activity of the organisms was effected to a great degree by the salt content of the butter. The butter containing salt above the one per cent level showed very little deterioration which could be correlated with the activity of microorganisms. Also the proportion of the organisms which were either lipolytic or proteolytic was greater in the butter held at the lower temperatures. The lack of agreement between the room temperature holding test and keeping quality at lower temperatures, therefore, appeared to be due to the differences in the active bacterial flora at these temperatures. This was particularly true with butter of salt content below one per cent and with unsalted butter.

M27. Laboratory Equipment for High Temperature Pasteurization Studies. S. T. COULTER AND W. B. COMBS, University of Minnesota.

Commercial equipment for experimental work in high temperature pasteurization is prohibitive in original and operation cost for most Experiment Stations. A pasteurizer, very moderate in cost and sufficiently small so that lots of cream such as would be available in feeding trials with individual cows can be readily handled, has been constructed and operated. The basic principle of operation is the same as that used in the high temperature pasteurizer made by the C. E. Rogers Co. of Detroit, Michigan. The equipment consists essentially of a glass tube connected at one end by means of rubber tubing with sources of cream and steam both under 50 to 60 pounds pressure, and at the other end by the same means to a flask upon which a partial vacuum can be drawn.

The glass tube is 3 feet long and is made of standard 12 mm. O. D. Pyrex tubing. The cream and steam enter the tube through the arms of a Y. Tubes drawn to a 3 mm. orifice are fitted into the arms of the Y in order to cause the cream and steam to meet as sprays. The rate of passage of the heated cream from the tube is regulated by a stopcock placed near the end opposite that at which the steam and cream enter. A thermometer is inserted into the tube by means of a ground glass connection and is held in place by spring clips. Leaving the tube the cream enters a 6 liter Erlenmeyer flask through an opening about half way up the side of the flask. The vapors are drawn off and passed through a surface condenser and a partial vacuum maintained by means of a water aspirator. All glass blowing was done by E. F. Greinke, of the Scientific Apparatus Shop, University of Minnesota.

In operation steam under pressure is admitted to the tube and after flow is established the outflow restricted by the stopcock until a temperature of at least 129° C. (265° F.) is reached. Cream under pressure is then admitted to the tube at such a rate as to maintain the temperature at 129° C. (265° F.) or above.

Numerous lots of cream so pasteurized gave zero bacterial counts using the standard plate method, and were practically free from cooked flavor.

M28. Correlation Between Grades on Scores and Grades on Criticisms in the Judging of Dairy Products. G. M. TROUT, Michigan State College.

Studies were made on the grades obtained of 69 contestants in the judging of seven samples each of butter, cheese, milk, and ice cream in the 1938 National Dairy Products Judging Contest. The grades represent 483 sample-judgments per product. Grouping of contestants according to their abilities to score a product indicated little difference between the good and poor

judges in their abilities to criticize the product; whereas grouping them according to their abilities to criticize the samples showed that these who had ability to criticize samples also had ability to score the product. Correlation coefficients between grades on "scores" and grades on "criticisms" for 69 individuals were .31, .82, .32, and .45 for butter, cheese, milk and ice cream respectively. Those for the team grades were .87, .67, .26, and .46 for the same respective products. Charts showing lines of regression between team grades on scores and grades on criticisms are included.

M29. Standards for Rating Cheddar Cheese. J. C. MARQUARDT, New York Agricultural Experiment Station, Geneva, N. Y.

Recent studies at the New York Agr. Exp. Station have revealed that the salt percentage in cheddar cheese influences its flavor, texture, and fitness for long curing.

It is proposed, therefore, to present a score card that will allow 5 points for salt. Regardless of whether the cheese is rated on flavor with 50 or 45 points, and on texture with a corresponding 25 or 30 points, the 5 points allowed for salt should reduce the perfect finish from 15 to 10.

In view of established facts the following scale is proposed for rating cheese on the salt basis.

CHEESE SCORE CARD

Flavor	50
Texture and body	25
Color	10
Finish	10
Salt	5

Salt in cheese—Perfect Score, 5

	Points
1.50–1.70 per cent	5.0
1.30–1.49 or 1.71–2.00 per cent	4.9
1.10–1.29 or 2.01–2.20 per cent	4.5
0.90–1.09 or 2.21–2.40 per cent	3.5
Below 0.90 or above 2.40 per cent	0.0

C. F. (cheese flavor rating)—

Allowing 5 points for a perfect rating on salt is a minor but important change in rating cheddar cheese. Its main advantage is as a guidance to a proper salt content in the cheese. Obviously when cheeses are more generally analyzed for salt either by control or commercial laboratories, the makers will become aware of the fact that quality and a proper salt content are closely related.

The item of cheese flavor is important and should be included on score cards. For example, cheeses with comparable scores may vary in cheese flavor. Lacks cheese flavor, mild cheese flavor, good cheese flavor or strong flavor are suitable designating terms which can be empirically expressed in

corresponding values of 50, 60, 75 or 95. Using these numbers with a cheese score may be confusing. However, two possibilities for recording C. F. (cheese flavor) are presented.

M30. Observations on the Growth Responses of *S. Lactis* in Mastitis Milk. C. C. PROUTY, Washington Agricultural Experiment Station.

The experiments reported are confined largely to studies made on the milk drawn from the normal and diseased udder quarters of three cows.

Milk with an initial pH value greater than 6.9 usually failed to support the growth of *S. lactis* in an active manner thus resulting in delayed acid production. Numerous samples with pH values greater than 7.0 showed no appreciable growth of *S. lactis* whereas normal samples from the other udder quarters showed normal acid development. Adjusting the pH value of mastitis milk to that of normal milk resulted in only partially overcoming delayed acid development. The addition of mastitis milk to normal milk in as little as 10 per cent concentrations had a retarding effect upon *S. lactis* development. Pasteurizing some samples at 150° F. and 155° F. for 30 minutes partially overcome the retarding influence on the growth of *S. lactis* but with most of the samples little or no effect was evident.

M31. Potentiometric Studies with Resazurin and Methylene Blue in Milk. C. K. JOHNS AND R. K. HOWSON, Department of Agriculture, Ottawa, Canada.

Resazurin reduces to the pink stage in approximately three-fourths of the time required for methylene blue to decolorize. Potentiometric studies indicate that this shortening of reduction time is attributable to the changes in shape of the time-potential curve when resazurin is present. The resazurin-milk curve reaches the zone of reduction earlier than does methylene blue. This is followed by a flattening of the curve due to the greater poising action of this dye.

Hourly inversion of tubes during incubation generally shortens the reduction time considerably. The incorporation of oxygen by this practice has little or no effect upon the time-potential curve during the early stages, and only a transient effect later.

Resazurin is more useful than methylene blue in detecting milks containing large numbers of weakly reducing organisms.

The lengthening of reduction time when the concentration of methylene blue is increased from 1 : 700,000 to 1 : 300,000 appears to be attributable to a downward shift in the Eh zone at which the dye decolorizes.

M32. Lactic Acid Streptococci of Cheese Starters. BLYTHE A. EAGLES AND OLGA OKULITCH, The University of British Columbia, Vancouver, Canada.

A study of streptococci isolated from cheese starters has been made, employing methods used by different workers in this field for the classification of the microorganisms.

The ability of the organisms to grow in methylene blue milk, in 4 per cent sodium chloride broth and in nutrient broth of pH 9.2 after the manner of Sherman; the nature of their growth in glucose broth as described by Davis; their vitality as measured by the technique of Whitehead, and their ability to ferment carbohydrates as measured quantitatively according to the method of Orla-Jensen have been determined.

The relationship of these procedures insofar as classification of the Lactic Acid Streptococci is concerned is considered.

M33. Application of the Smear Culture Technique to the Examination of Cheddar Cheese. C. B. LANE AND B. W. HAMMER, Iowa State College.

The plating of cheddar cheese on various media has been useful in showing the general changes in numbers of bacteria during manufacture and ripening but has not been particularly helpful in studying some of the bacteriological problems involved in cheese ripening. The advantages of the smear culture technique in the examination of butter and ice cream suggested its application to cheese.

In carrying out the technique uninoculated plates were poured and allowed to solidify. The weighed sample of cheese was ground with 2 per cent aqueous sodium citrate and dilutions made in sterile water. One-tenth ml. portions of each dilution were smeared on the plates with sterile bent glass rods. After inoculating the plates at 21° C. for about 1 week they were examined for the numbers and general types of colonies present.

The technique was compared with the usual plating procedure. Beef infusion agar was employed with both methods since preliminary trials had indicated it was more generally satisfactory than agars prepared from tomato juice, cheese infusion or milk.

The general results of the comparison are as follows: 1. Higher total counts were generally obtained with poured plates. 2. Colonies were larger and developed more rapidly on smeared plates. 3. More of the rapid acid producing organisms, particularly *S. lactis*, were found on poured plates, whereas more of the chromogenic cocci and protein digesting types were regularly present on smeared plates.

The smear culture technique appears to have advantages over the plating procedure in studying the bacteria other than the homofermentative lactic acid organisms in cheese.

M34. Relationship of Fat Hydrolysis to Flavor Development in Cheddar Cheese. C. B. LANE AND B. W. HAMMER, Iowa State College.

The relatively large acid numbers obtained on fat from aged cheddar cheese, and also the higher acid numbers accompanying the more rapid flavor development in raw milk cheese than in pasteurized milk cheese, suggest that changes in the fat may be important in the ripening process.

In order to study hydrolysis of the fat, cheeses were prepared from normal milk (raw or pasteurized) and also from milk which had been separated, the cream homogenized (raw or pasteurized) and then recombined with the skim milk (raw or pasteurized).

A rancid flavor regularly developed very early in cheese from homogenized raw cream plus raw skim milk and, to a lesser degree, in cheese from homogenized raw cream plus pasteurized skim milk. As ripening progressed, the rancid flavor rapidly diminished; after 4 to 6 weeks, it has completely disappeared. Following disappearance of the rancid flavor, a flavor characteristic of aged cheddar cheese developed; after 8 weeks, considerable flavor was present. Cheese from homogenized raw cream (plus raw skim milk) regularly developed more flavor than cheese from homogenized pasteurized cream (plus pasteurized skim milk) or from normal pasteurized milk; in most instances it developed more flavor than cheese from normal raw milk. The results suggest the importance of milk lipase in the ripening process.

Since a rancid flavor rapidly developed and disappeared in the cheese from homogenized raw cream (plus skim milk) it is evident that factors were present which resulted in the destruction of the fatty acid or acids responsible for the rancid flavor. Presumably, these factors are also operative in cheese made from normal milk and because of the relatively slow production of the acids a rancid flavor does not develop.

M35. Some Factors Affecting the Moisture Content of Swiss Cheese and Their Effects upon Quality and Yield. GEORGE P. SANDERS AND ROBERT R. FARRAR, U. S. Bureau of Dairy Industry.

Data on nearly 200 laboratory Swiss cheeses, each weighing about 60 pounds and cured 2½ to 3 months, indicate that the inclusion of more than 39.7 per cent moisture in green cheese usually results in serious detriment to the quality of the cheese, particularly with respect to eye formation. The conclusion that high moisture is detrimental to quality is substantiated by results of analyses of nearly 400 factory cheeses in 3 years' study in producing areas in Wisconsin and Ohio.

Conditions which were found to increase the percentage of moisture in laboratory cheese are: low-fat milk, soft-curd milk, addition of sodium citrate or of water to milk, slow pH development caused by a decrease in activity of streptococcus starter or by "slow-working" milk, decrease in quantity of rennet, low setting temperature, early cutting, fine harping, rapid heating, a combination of low cooking temperature and short stirring-out time, and a general shortening of time of each stage of the making process.

Increases in percentages of moisture did not result in corresponding increases in yield. Some of the above factors which cause increases in moisture content in cheese likewise cause abnormal losses of fat and other solids in the whey; such factors include the use of soft-curd milk, "slow-working" milk, slow pH development, and fine harping. Removal of an excessively large proportion of fat from the milk produces, in addition to low yield, high moisture content and poor quality. High-moisture cheeses undergo a relatively large loss in weight during curing.

M36. Further Studies on the Gas Requirements of Three Strains of Blue Mold (*Penicillium Roqueforti Group*) Isolated From Cheese.
N. S. GOLDING, Washington Agricultural Experiment Station.

The paper presents further data, obtained during the last two years on the gas requirements of blue mold (Penicillia) isolated from blue veined cheese. The data are expressed by growth curves and each point represents the average measurement of the diameter of five colonies incubated for each of seven different temperatures under identical conditions of gas supply. A seven-day incubation period and the same lot of Difco malt agar were used for all growth curves. With all curves growth is selected as the Y-axis and temperature as the X-axis. Thus by interpolation from the growth curves, other curves can be made for any growing temperature, with growth as the Y-axis and concentration of any one of the gases used as the X-axis. Tables also are interpolated from the growth curves for definite temperatures of growth. In these tables the control, air, is given the value of 100. Significant deviations are at once apparent when using any known gas mixture.

The growth curves of three strains of *P. roqueforti* are given for six dilutions of air (less CO_2) with N_2.

The curves show:

Where air is diluted up to 50 per cent added N_2 by volume, no significant difference in growth is recorded.

With a gas supply of air 30 per cent and added N_2 70 per cent, a very slightly significant inhibition in growth with one culture is recorded. The other two cultures are not significantly inhibited.

A gas supply of air 20 per cent and added N_2 80 per cent, produced no inhibition in growth at 60° F., slight inhibition in growth at 70° F. and a somewhat greater inhibition at 80° F.

Up to and including air 20 per cent and added N_2 80 per cent (*i.e.*, 4 per cent O_2) inhibition did not exceed 15 per cent of the control, air.

With gas supply of air 10 per cent and added N_2 90 per cent (*i.e.*, 2 per cent O_2) growth is inhibited, however, in eight out of nine cases growth was more than 50 per cent of the control, air.

Inhibition is greater at higher temperatures of growth than at the low.

The growth curves of the three strains of *P. roqueforti*, are given for 8 dilutions of air with CO_2.

The curves show:

With small additions of CO_2 to air, up to 10 per cent and in some cases higher, there is an increase in the growth, which is variable both with temperature and strain of organism.

Up to CO_2 30 per cent and air 70 per cent inhibition in growth is not noticed with the exception of low temperatures of growth and is variable with the strains of mold.

With equal parts CO_2 and air inhibition of growth is definite at all temperatures but is very much greater at the lower temperatures than at the higher temperatures. The area enclosed below the growth curve, which represents the average growth for all temperatures is of the same order as that obtained for 90 per cent added N_2 in air (*i.e.*, 2 per cent O_2).

With CO_2 70 per cent and air 30 per cent growth is totally inhibited during one week at temperatures of 55° F. and below, while at 70° F. growth is about 50 per cent of the control, air, however, there is considerable variation between strains.

The inhibiting effect of CO_2 is much greater at low temperatures of growth than at the higher temperatures which, is directly the opposite to that obtained with N_2.

M37. The Lipolytic and Proteolytic Activities of Various Penicillia of Importance in the Ripening of Blue Cheese. C. JENSEN, North Dakota Agricultural Experimental Station.

In a study of 27 strains of penicillia obtained in part from culture collections and from blue cheese isolations, considerable variations were noted in their lipolytic activities on natural fats (butterfat and cottonseed oil), and on various simple triglycerides, dispersed in Czapek's solution agar, as determined by the natural fat and the Nile blue sulfate technics.

The strains of penicillia studied also exhibited significant differences with respect to their proteolytic activities as shown by their action on skim milk contained in Czapek's solution agar.

PRODUCTION SECTION

P1. The Lactation-Promoting Properties of Proteins as Measured With Rats. J. R. HAAG AND L. D. WRIGHT, Oregon Agricultural Experiment Station.

Specific information on the lactation-promoting properties of proteins is largely limited to the knowledge that a liberal protein intake is essential for a high level of lactation. The extent to which conventional biological values and growth-promoting properties are applicable to lactation is still problem-

atical. Experiments conducted in our laboratory have thus far been largely confined to the proteins of alfalfa leaf meal, corn gluten meal, peanut meal, and to the amino acids cystine and methionine.

We have previously shown that the growth-promoting and lactation-promoting properties of alfalfa leaf meal protein are enhanced by additions of l-cystine. Of particular interest to the northwestern states is the fact that all samples of alfalfa thus far tested, regardless of sulphur fertilization history, have been improved by the addition of cystine. We have also found alfalfa crude protein to contain a relatively constant percentage of organic sulphur. The conclusion of practical interest is that while sulphur fertilization frequently increases the yield of crude protein, it apparently does not affect its biological value for growth or lactation.

Another phase of our work deals with a quantitative comparison of the influence of different levels of cystine on growth and on lactation in rats fed rations containing 9–10 per cent alfalfa crude protein. Under the conditions of these experiments we have failed to demonstrate any significant difference in the requirements for growth and for lactation.

Still another group of experiments in which the protein is furnished by peanut meal deals with the conditions governing the interchangeability of cystine and methionine. Growth and lactation are not improved by the addition of cystine but respond to methionine. Here again, we have failed to demonstrate any fundamental difference in the requirements for growth and for lactation.

The study of supplementary effects among proteins on lactation is a difficult problem. The proteins of corn gluten meal do not appear to make good the cystine deficiencies of alfalfa crude protein. Experiments are now being planned to determine the supplementary effects of various feed proteins on the lactation-promoting properties of alfalfa proteins.

P2. Recent Advances in the Endocrinology of Milk Secretion.* C. W. Turner, Missouri Agricultural Experiment Station.

One of the most intriguing problems confronting breeders of dairy cattle is the explanation of the physiological expression of the genetic differences for milk production. By what means are the cows which receive the potential ability for large milk secretion enabled to utilize and convert the large amounts of feed received into milk? Work under way at this Station leads us to believe that the variation in the secretions of the endocrine glands causes the difference. The master gland of the endocrine system is the pituitary. It plays a unique rôle in regulating the growth and secretory activity of the udder, the largest gland of the body.

The pituitary secretes a hormone called *mammogen*, which stimulates the growth of the udder slightly during the recurring estrus cycles and very

* Contribution from the Department of Dairy Husbandry, Missouri Agr. Exp. Sta., Journal Series No. 602.

greatly during the first two-thirds of pregnancy. Small amounts of mammogen may be present in the pituitary at all times but it has been shown that the ovarian hormones, estrogen and progestin, which are secreted in large amounts during pregnancy cause the pituitary to secrete large amounts of this hormone. In comparisons of beef and dairy cattle pituitaries during pregnancy, more mammogenic hormone is being found in the latter. It seems reasonable to believe that the size of the udder is controlled in part by the rate of secretion of mammogen.

When the growth of the udder is completed, the secretion of milk must be initiated. A second pituitary hormone called *lactogen* starts the epithelial cells to synthesizing milk. We have discovered that the amount of this hormone increases very rapidly after calving and explains why milk production increases rapidly at this time. The pituitaries of dairy cattle have been shown to contain much more of this hormone than beef cattle.

The above hormones directly influence the udder. There are other pituitary hormones, however, which have an important indirect effect upon lactation through their action upon the absorption of food, the composition of the blood, the rate of circulation of the blood, and the activity of the udder cells. In this class comes the pituitary thyrotropic hormone which stimulates the thyroid gland to increased secretion of thyroxine. We have discovered that the thyrotropic hormone also increases markedly following parturition and is present in higher concentration in dairy cattle than in beef cattle.

Further, it has been shown that the injection of thyroxine into some dairy cattle increases the secretion of milk during the period of treatment. Does this mean that the cow's own thyroid gland is not secreting optimum amounts of thyroxine for maximum secretion?

The pituitary has been shown to secrete hormones which influence the parathyroid and the adrenal glands as well. It also influences the metabolism of protein, fat and carbohydrates and may in this way regulate the rate of milk secretion through their action upon the precursors of milk in the blood.

P3. Some Factors Affecting the Reliability of Arterio-Venous Differences in a Study of Blood Precursors of Milk. W. E. PETERSEN AND W. L. BOYD, Minnesota Agricultural Experiment Station.

In the study of blood precursors of milk and the metabolism of the mammary gland by determining arterio-venous differences of the various blood substances, great variations in values are secured from time to time.

These variations may be due to normal changes in the blood substances, variation in the quantity of blood constituents removed by the gland or abnormal changes due to the act of taking blood samples. While the first two possibilities are undoubtedly contributing factors, the latter possibility must be given even more serious consideration.

Numerous blood volume changes were determined in arterio-venous samples in which the venous samples were taken simultaneously as well as immediately before and immediately after the arterial samples. The changes in blood volume may be either a dilution or concentration of the venous blood in relation to the arterial. As much as 5 per cent dilution and 11 per cent concentration were observed. Arterial samples taken at one minute intervals varied as much as 3 per cent. In excited animals large blood concentration changes were observed more frequently than in those not excited, although some very excited animals showed no change and some animals not visibly excited showed great changes.

Obviously when there are changes in the blood concentration the observed values should be corrected. When the arterio-venous difference of many substances are corrected for blood volume changes the corrected values often appear to be very abnormal.

Where there are no changes in blood concentration and no visible excitement of the animals, the observed variations must be explained some other way. Inasmuch as the water of the blood may go either way upon excitement, it seems probable that the act of taking blood samples may often cause pronounced almost instantaneous effects upon the blood and metabolism which may or may not be reflected in concentration changes of the blood. However, the most nearly constant arterio-venous differences in the blood precursors of milk are usually obtained when there are little or no changes in blood volume.

Variations in the arterio-venous differences can also be attributed to changes in blood flow through the gland and to endocrine and pressure effects in the letting down of milk. That there is a considerable variation in the blood flow is apparent from the large fluctuations in the amount of oxygen taken up by the gland. Data on perfusion experiments show that the failure of the gland to remove fat from the blood for an hour or so after milking is due to the endocrine effects causing the letting down of milk. Blood flow is also decreased due to this effect.

Variations in blood volume differences in arterial and venous samples are more closely associated with the excitation of the animal than are either glucose or phosphorus differences. The state of excitation of the animal is of more importance in drawing good blood samples than is the rapidity with which the samples are taken. It is suggested that only those samples showing little or no blood volume changes be used in studying milk secretion.

P4. The Respiratory Quotients of the Intact and Perfused Mammary Glands of Cows. J. C. SHAW, Minnesota Agricultural Experiment Station.

The respiratory quotients of both the intact and perfused excised mammary glands of cows were determined from arterio-venous blood samples.

The results in the case of the intact animal were difficult to evaluate because of the great variation and the necessity of correcting for blood volume changes in many cases. Correction for blood volume changes produced values that were obviously untenable. Uncorrected respiratory quotients varied from 0.56 to 2.26. Those corrected for blood volume changes varied from 0.22 to 0.986. Where no blood volume changes occurred the respiratory quotient varied from 0.93 to 1.70. The oxygen differences varied from 3.7 to 7.1 volumes per cent while the carbon dioxide differences varied from 2.2 to 8.4 volumes per cent.

For non-lactating glands the respiratory quotients were 0.20 or less in the intact gland. The oxygen consumption was much higher, reaching as much as 11.9 volumes per cent.

On the perfused excised lactating glands the respiratory quotients were much more constant, varying but little from a mean of 0.80. Although but few excised dry glands have been perfused the indications are that the respiratory quotients are about unity which is the value to be expected from the burning of carbohydrate. The respiratory quotient secured on perfused excised glands are significant in that the values for the excised dry gland are higher than the intact dry gland while for the lactating glands the values for the perfused gland are lower than the intact gland; also the values for the perfused non-lactating gland are greater than for the perfused lactating gland.

The values obtained on perfused lactating glands indicate that fats are oxidized and this lends support to the hypothesis previously advanced that milk fat is accounted for by the blood fat and that the lower fatty acids of milk fat are produced by partial oxidation of the higher fatty acids. Continued studies of the arterio-venous differences of blood fat show that sufficient fat is removed from the blood by the mammary gland to account for the milk fat.

P5. Perfusion of the Excised Mammary Gland as a Method of Studying Milk Secretion. W. E. Petersen, J. C. Shaw and M. B. Visscher, Minnesota Agricultural Experiment Station.

Perfusion, providing the excised mammary gland functions normally when perfused, offers the following advantages as contrasted to the living animal in the study of the blood precursors of milk:

1. The many factors, outside of the mammary gland, affecting blood changes are eliminated.
2. Through continued perfusion of the same blood it becomes possible to detect some of the milk precursors that are removed in minute amounts.
3. It becomes possible to study the effects of partial or complete depletion in the blood of the several milk precursors.

4. It becomes possible to study the effect upon milk secretion of substances added to the blood.
5. The rate of blood flow through the gland can be accurately determined at all times.
6. The effect of varying blood pressures can be studied.
7. It becomes possible to secure the lymph and determine its composition.

Two methods have been used in perfusion, one involving the Starling-Visscher heart-lung preparations of goats and the other an artificial heart and lung for perfusion of cow glands.

A fairly satisfactory perfusion apparatus and technique have been developed and some significant results have been obtained relative to the metabolism of the excised gland. The apparatus consists of an artificial heart, resistance for maintaining constant blood pressure, a constant water bath for maintaining blood temperatures, and an oxygenator. Both the gland and defibrinated blood are obtained from cows at the time of slaughter. The gland is suspended from the median suspensory ligament and skin. The gland seems to function normally even when as much as one hour has elapsed between the time of slaughter and the start of perfusion.

As evidence that the perfused excised gland functions normally, the following observations have been made:

Glucose is used constantly and is rapidly depleted in the blood.

Blood fat is used by the perfused gland and the same relationship between the arterio-venous difference and the time of milking as was observed in the normal cow is maintained in the perfused gland.

Nitrogenous substances are also used, and the great variations in the blood nitrogen of the normal cow which practically renders interpretations impossible are not observed in the perfused blood.

The respiratory quotient of the perfused gland in all experiments has been remarkably constant on the original blood.

With the depletion of certain blood constituents the respiratory quotient of the perfused lactating gland decreases.

P6. The Effect of Ultraviolet Radiation on Milk Production. W. E. KRAUSS, C. F. MONROE, C. C. HAYDEN, AND B. H. EDGINGTON, Ohio Agricultural Experiment Station.*

Ninety-six Holstein cows in the dairy herd at the Ohio State Reformatory (Mansfield), were classified on the basis of their agglutinin titers as determined by two agglutination tests run in successive months. The cows were classed as non-reactor, questionable, and reactor animals and were divided into two groups, each of which contained an equal number of animals showing the same reaction.

* In cooperation with the State Department of Public Welfare and the General Electric Company, Nela Park, Cleveland, Ohio.

One group of cows served as controls while the other was irradiated with ultraviolet light generated by S–1 sunlamps which were so placed that maximum exposure occurred on the head region. In the course of a year it was calculated that the irradiated group received the equivalent of 100 hours of midsummer sunshine over and above the natural sunshine to which both groups were exposed.

All the cows were fed and treated alike in accordance with the routine system of feeding and managing this herd. Daily milk production records were kept and the milk from each cow was tested for butterfat once a month in each trial except the last when it was tested weekly.

Various treatments of the production data obtained during the first year yielded no significant difference in performance of the two groups of cows.

During the second year the irradiated cows were subjected to about three times as much ultraviolet as during the first year. Again no significant difference in production was obtained. A combination of data for the two years showed the average daily production of 4 per cent milk for 34 check cows to be 31.9 pounds, and of 36 irradiated cows 32.4 pounds.

Two additional trials were run in which previous production performance, stage of lactation, etc., rather than agglutination titer, were used as a basis for dividing into groups. The significant analyses of the data obtained were based on paired performance during the experimental period as compared to performance in a preliminary period. The amount of ultraviolet radiation given was much greater than that used in the previous trials and approached the daily equivalent of 10 hours of midsummer sunshine.

In the first of these trials (6 pairs) the irradiated cows produced 0.75 pound of 4 per cent milk more daily than was expected, based on the performance of the control cows during the 91-day experimental period. In the second trial (8 pairs), over a period of 172 days, the irradiated cows produced 0.79 pound of 4 per cent milk more daily than was expected.

It is concluded that the light sources used (S–1 and S–4 lamps) had no effect on milk production.

P7. Studies on Milk and Fat Production of Dairy Cows and Goats as Influenced by Thyroxine.* N. P. RALSTON, C. W. TURNER AND A. C. RAGSDALE, Missouri Agricultural Experiment Station.

The initiation and maintenance of milk secretion has been definitely demonstrated to be influenced by numerous hormones. Thyroxine, a secretion of the thyroid gland, has been shown in recent experiments to augment milk and fat production.

In recent investigations at this station eighteen cows received 90 injections of thyroxine at monthly intervals during their lactation periods. The

* Contribution from the Dept. of Dairy Husbandry, Missouri Agricultural Experiment Station, Journal Series No. 608.

hormone was injected subcutaneously, in an alkaline solution, at the rate of 15 mg. per day for three successive days during each month. This treatment caused an average increase in milk production of 13.6 per cent, increased the total pounds of fat 22.5 per cent, the per cent of fat 4.75 per cent, the total pounds of solids-not-fat 14.7 per cent, and a slight increase in the per cent of solids-not-fat. The pulse rate increased an average of 7.64 beats per minute, while body temperature remained within normal range.

Milk production reached its maximum on the sixth and seventh days after starting the injection. Milk production then returned gradually to its normal level by the 12th to 14th day. Cows in the second to ninth month of lactation showed a greater response than cows in first, tenth, eleventh and twelfth months of their lactation.

A study of the blood constituents of four goats injected with thyroxine was made in order to note changes of milk precursors during the increased milk production. The goats were given subcutaneously 12 mg. of thyroxine in alkaline solution during the late declining phase of their lactation period. Milk and fat production increased on the average of 67 per cent. The osmotic pressure of the blood serum and the milk indicated no significant change. Blood sugar and blood fat showed a reciprocal relationship. Blood sugar increased during the first part of the experiment while blood fat decreased. During the latter portion of the experiment the opposite trend was shown. The percentage of lactose increased while the percentage of milk fat declined throughout the experiment. Total nitrogen and non-protein-nitrogen declined slightly both in blood and milk during the entire period of two weeks.

There was a definite increase in the respiratory rate with a slight increase of body temperature. Heart rate increased markedly. Systolic blood pressure increased slightly except in cases where very high heart rate was noted.

Prolonged hyperthyroidism in humans have in some cases shown deleterious effects on the cardio-vascular system. Electro-cardiographic records have been taken of goats and cows given thyroxine in order to determine if any ill effects develop. At the present time no cardio-vascular damage has been noted. However, the period of thyroxine injection has been too short to draw definite conclusions. This study is being continued.

P8. Two Methods of Feeding Soybean Fat to Cows and Their Effect on Milk and Butterfat Production and on the Nature of the Butterfat. N. KENNETH WILLIAMS, C. Y. CANNON AND DWIGHT ESPE, Iowa Agricultural Experiment Station.

In one of a series of experiments on soybean feeding conducted at the Iowa station, two groups of cows were used in a double reversal trial of four week periods, in which the rations of alfalfa hay, corn or sorghum silage and grain were identical except that the soybeans in one grain mixture (1 corn,

1 oats, 2 cracked soybeans) were replaced in the second by the soybean oil meal and soybean oil obtained by processing part of the soybeans at a low temperature so as not to alter the biological value of the protein. The grain was mixed weekly in order to avoid rancidity. Feeding was regulated so that each cow received from the grain about eighty per cent as much fat as she secreted in her milk.

The results obtained were quite marked and consistent with previous observations made at this station. Milk production averaged 7.8 pounds per cow per week more on the "oil" ration. However, without exception, the cows produced more butterfat when the cracked soybeans were fed. The mean advantage of the soybean ration in butterfat percentage was 0.34. From comparison with production during the preliminary period when a "normal" grain ration was fed and from data obtained from previous experiments, it is evident that both types of feeding were responsible for the trends; that is, the feeding of cracked soybeans decreased milk production and increased butterfat production and fat percentage; while the feeding of soybean fat as oil increased milk production but decreased butterfat production and fat percentage.

Changes in live weight of the cows were erratic and non-significant. Chemical and physical measurements were made on the butterfat obtained from periodic group and individual samples of milk. Both rations caused great changes in the distribution of fatty acids as indicated by various constants. However, the "oil" ration caused the most profound changes; during the periods when this ration was fed the iodine and thiocyanogen-iodine values were at their maximum and the Reichert-Meissl and Polenski values at their minimum. Calculation of the content of linoleic (or its optical isomer) and oleic acids (based on iodine and thiocyanogen-iodine values) showed that the oleic acid content was highest during the oil feeding periods and the linoleic acid during the soybean feeding periods. This indicates that the nature of fat metabolism was affected by the method of feeding fat since the total unsaturation in the butterfat was greater when the oil was fed, but the conversion of linoleic acid to more nearly normal constituents of butterfat was more nearly complete.

Churning time of butter was increased during the period of "oil" feeding over the "soybean" periods. Both rations decreased the color of the butterfat compared with normal rations but with the method used to measure color it was not possible to differentiate between their effects. Both rations increased the melting point of the butterfat over that produced by the normal preliminary ration but there was no marked difference in the effects of the two trial rations.

The changes in milk production, per cent butterfat, butterfat production, iodine and thiocyanogen-iodine values, per cent oleic and linoleic acids were subjected to statistical analysis. All were highly significant (one per cent level) or significant (five per cent level).

P9. The Effect of Sulfanilamide Therapy upon the Catalase Activity of the Blood and Milk. A Preliminary Report. P. G. MILLER AND G. W. ANDERSON, South Carolina Agricultural Experiment Station.

Sulfanilamide has been used successfully for the past two years for the treatment of mastitis in the college herd. Recently Locke, Main and Mellon (Science, Dec. 30, 1938) proposed the theory that sulfanilamide was effective in retarding infections due to pneumococcus and hemolytic streptococcus indirectly by sulfanilamide oxidative products formed within the multiplying organisms having sufficient anti-catalase action to permit injurious amounts of hydrogen peroxide to be accumulated.

The action of organisms in a case of streptococcic mastitis is believed to be confined to the udder; so if anti-catalase, as postulated, should be present in the blood stream of an animal having only such an infection, it would necessarily come from the udder. Preliminary work in which sulfanilamide was given to cows emitting streptococci in the milk but not showing clinical symptoms of mastitis have not shown any definite effect on the blood catalase activity. Neither has the milk catalase activity shown any significant trends that can be definitely attributed to sulfanilamide therapy.

Determinations are being made to compare the effect of various conditions upon the catalase activity of the blood of the mammary veins and an ear vein, and of the milk from individual quarters; that is, while the cow is in normal health, during an artificially infected acute case of mastitis on one side of the udder, during sulfanilamide therapy and recovery.

P10. The Effect of Ultraviolet Radiation of Cows On Their Agglutinin Titer for Bangs Disease. B. H. EDGINGTON, W. E. KRAUSS, C. F. MONROE, AND C. C. HAYDEN, Animal Disease Research Laboratories and Department of Dairy Industry, Ohio Agricultural Experiment Station.*

The object of this experiment was to ascertain the effect, if any, that ultraviolet radiation of cows in a Bangs diseased herd might have on the course of the disease in the herd, as determined by monthly agglutination titers of blood and milk from each cow.

The animals used were part of a state-owned Holstein herd in which Bangs disease had existed for several years. The animals were separated on the basis of their age (2–12 years) and agglutinin titers into two groups designated as Control and Irradiated. The cows were classified as nonreactor, questionable and reactor on the basis of the agglutinin titer of their blood. Data were compiled only on those animals that were under observation during the entire 29 months of the experiment. The Control group contained 31 cows and the Irradiated group 24 cows.

* In cooperation with the State Department of Public Welfare and the General Electric Company, Nela Park, Cleveland, Ohio.

During the first year S-1 sunlamps were used for irradiating the cows of the Irradiated group. It was calculated that the group received during the year the equivalent of approximately 100 hours of midsummer sunshine, in addition to the natural sunshine to which the cows of both groups were exposed. During the second year the cows were exposed to about three times as much ultraviolet as during the first year.

The classification of the animals, based upon their agglutinin blood titers at the beginning and termination of the experiment, showed the following changes: In the Control group, the 11 cows that were originally non-reactors remained non-reactors; 2 of the 9 questionable ones became non-reactors, and 2 of 11 reactors became questionable. In the Irradiated group one of the 7 non-reactor cows became questionable; 5 of the 10 questionable ones became non-reactors, and the 7 reactors remained in that class.

The titer of agglutinins in the milk from different quarters of the same cow was variable and in a few tests was higher than that of the blood collected on the same day. One non-reactor and two questionable cows of the Control group and all the reactors of both groups gave questionable or reactor titers in one or more quarters at least once in the series of tests. No other cow of either group had a titer exceeding that of a non-reactor.

During the period of this experiment 101 pregnancies occurred—56 in the Control and 45 in the Irradiated group. Five of these gestations terminated in abortion; however, *Br. abortus* was demonstrated in but one of the fetuses. These results, plus the fact that but one of the non-reactor cows of both groups aborted, indicates that the intra-herd spread of *Br. abortus* was probably very limited.

This experiment fails to give evidence that the light sources used in this herd had a significant effect on the course of Bangs disease under the conditions of this particular experiment. It should be pointed out, however, that the ultraviolet light employed ranged in wave length from 2800 to 3200 Ångstrom units which does not include the sterilizing range.

P11. A New Routine Extending the Usefulness of the Hotis Test for Mastitis. J. FRANK CONE, U. S. Bureau of Dairy Industry.

Criticism has been directed at the Hotis test because of the number of borderline or "suspicious" reactions. This objection to the test can be overcome by combining it with the microscopic examination of the incubated sample. Quantitative experiments show that the concentration of dye in the Hotis test is not so great that it will delay or retard the growth of mastitis streptococci.

With the new routine, the Hotis test is set up in the usual manner, *i.e.*, adding 9.5 ml. of the sample to 0.5 ml. of 0.5 per cent brom cresol purple solution in a test tube. Immediately a record is made of each tube, showing whether the milk is normal or alkaline in reaction. The tubes are incubated

at 37° C. for 20–24 hours and examined for the characteristic canary yellow flakes, with or without the development of acid in the milk. A distinctly positive test is considered complete and examined no further. All "suspicious" or negative samples are then examined microscopically for the presence of long-chain streptococci.

One thousand and ninety-seven individual quarter samples have been examined in this manner and with direct plating on Edward's aesculin blood agar. Of these, 187 samples were found to contain mastitis streptococci. The Hotis test gave 125 positive reactions, all of which were confirmed on Edward's agar. It gave negative reactions on 898 samples, 8 of which showed streptococci in the smear and on the blood-agar plates.

It is believed the additional information obtained with little additional labor involved by combining the tests is a distinct advantage.

P12. The Classification of the Streptococci of Bovine Mastitis. R. B. LITTLE AND F. C. MINETT, The Rockefeller Institute for Medical Research, Princeton, N. J., and Royal Veterinary College, Camden Town, London.

The purpose of this note is to call the attention of workers who are interested to a project initiated by one of us (R.B.L.). The necessity for trying to get some orderly arrangement of the streptococci which may be associated with bovine mastitis has long been obvious. Not only is this so on the grounds of bacteriological nomenclature, but, unless investigators in different parts of the world use the same designations, it is difficult or impossible to make those comparisons which are essential for a proper understanding of the subject and in consequence scientific progress is impeded. To give an example. The term "Streptococcus mastitidis" has been used in the past for more than one kind of mastitis streptococcus, whereas in fact it is now known that there are several kinds of streptococci recognized by experienced workers as capable of causing different forms of the disease. Moreover, only one of these forms is known to spread easily in a herd. The subject of classification, therefore, has a clear relation to preventive and clinical veterinary medicine

Briefly, we have decided to ask those who are studying mastitis to communicate with us. Persons resident in the American continent and Japan should write to Dr. Little, while those in Europe and the British Empire, are requested to get into touch with Dr. Minett. Persons who are interested would then be requested to re-examine their cultures (1) by means of a group B standard serum which would be issued (2) by certain relatively simple cultural and biochemical methods. Mimeographed copies of suggested methods for carrying out these tests and forms for recording the results would be sent out at the same time, to be returned as soon as possible to Princeton or to Camden Town, as the case may be. Cultures giving

"atypical" reactions should be sent for re-examination to one or other of these centers. Type strains would be issued on request for purposes of comparison. Later on, the results of the enquiry would be circulated to all concerned and then, if the majority of workers agreed, they could be published in summary form, with particular reference to "atypical" strains.

P13. Results of a Long Time Feeding Experiment on Bone Meal vs. No Bone Meal in a Dairy Ration Consisting of Timothy Hay, Corn Silage, and Concentrates. S. I. BECHDEL, P. S. WILLIAMS, A. A. BORLAND, AND J. F. SHIGLEY, The Pennsylvania State College.

In order to study the advisability of mineral supplements in the dairy ration, a long time practical experiment was conducted at the Pennsylvania Experiment Station. This experiment was carried out under the conditions that usually exist on a modern practical dairy farm. High grade Holstein cows were used. The whole herd was on pasture (usually fertilized) during the summer months. During the remainder of the year they were housed in a modern barn. The roughages consisted of timothy hay, usually early cut and of high grade, and corn silage. This roughage combination is commonly fed on Pennsylvania dairy farms. The concentrate mixtures fed usually contained about 18 per cent crude protein. Two per cent steamed bone meal was added to the mixtures when the experimental set-up called for it. A total of thirty-three cows with one hundred seventeen complete lactations were studied. Ten of the cows were carried on either the basal ration or the ration containing bone meal until removed from the herd. On twenty-three of the cows the rations (bone meal *vs.* no bone meal) were reversed every lactation. The milk records were corrected to four per cent fat, three time milking, and maturity.

The milk production for the twenty-three cows that were on both rations averaged 8653.9 pounds when they received the basal ration and 9008.1 when they received the ration containing bone meal. This difference appears to be due to a slightly longer lactation (10 days) when the cows received bone meal. The cows receiving the bone meal also produced slightly more milk per pound of grain (3.07 for the basal and 3.134 for the bone meal group) than did the group on the basal ration. One and seventy-three hundredths services were required for conception when the cows received the basal ration and 1.59 services when the cows received bone meal. A few cows that received the bone meal ration for two or more years in succession required only 1.33 services in the second year on bone meal. The calves from cows that received the bone meal weighed on the average three pounds more at birth. No significant differences were observed in the general health of the animals, and the incidence of mastitis or other pathological conditions that might be caused by mineral deficiencies.

The results of this experiment show conclusively that no outstanding deficiency of minerals resulted under the conditions of this experiment when the cows were fed a ration containing no bone meal. These cows were all grazed during the summer months on pastures treated with mineral fertilizers, and this pasture may have helped out in supplying any possible deficiency of minerals.

Although the differences in favor of bone meal are small, the results are consistent enough to make them of real significance. The additional milk produced was sufficient to net a return three to four times the cost of the bone meal.

P14. Making and Feeding Air Dried Hay to Dairy Heifers. C. E. Wylie and S. A. Hinton, University of Tennessee, J. W. Weaver, Jr., Tennessee Valley Authority.

Many sections of the country have difficulty in curing hay after a good crop is grown. This is due to damage by rain. Then, too, there is considerable loss by shattering of leaves in curing hay in the field. For many years there has been an attempt to improve hay curing by the use of large commercial hay driers requiring heat. At the University of Tennessee there has been developed during the last four years a drier which cures hay in the barn loft without the use of heat.

This new process includes a series of wood ducts on the floor of the hay loft. Air is forced through these ducts and through the hay by the use of a 5 hp. electric motor and a blower which delivers 12,000 cu. ft. of air per minute. The hay, in the case of alfalfa, is allowed to cure about four hours in the field when it will contain about 50 per cent moisture. At this stage it is limp and will not shatter. It is placed in the hay loft using the ordinary hay harvesting machinery. In the loft the forced air brings the moisture down to 20 per cent which is safe for storage.

Analyses of this hay, grading and feeding trials, indicate that it is superior to hay cured in the field. This includes two years of feeding trials with dairy heifers. The growth results were especially favorable the winter of 1938–39.

P15. The Nutritive Value of an Alfalfa Hay Ration Compared with a Mixed Grass and Legume Hay and Grass Silage Ration for Dairy Cattle. R. E. Hodgson and J. C. Knott, Washington Agricultural Experiment Station, Bureau Dairy Industry Cooperating.

Alfalfa hay grown in one of the irrigated alfalfa sections of central Washington was compared with mixed grass and clover hay and grass silage grown in western Washington as a ration for dairy cows. The alfalfa was

fed as the complete ration to one group of cows while the western hay and grass silage (home-grown ration) was fed as the complete ration to another group of cows.

The alfalfa used was Commercial U. S. No. 2 second cutting alfalfa. The home-grown mixed hay was U. S. No. 2 clover timothy and rye grass mix. It was harvested when clover was in about full bloom and the grasses fully headed. The grass silage was harvested in the early head stage. The two roughage rations were fed in amounts slightly in excess of what the cows would consume. In the hay and silage ration 58 per cent of the dry matter consumed was fed in the form of hay.

Duplicate experiments were conducted the first in 1937–38 with nine cows in each group fed for a period of 168 days. The second experiment was conducted in 1938–39 and four cows in each group were fed the two rations for 140 days. At the beginning of each experiment the two groups of cows were as nearly alike as possible in regard to production, age, weight and gestation.

The average protein content of the feeds was alfalfa hay 14.2 per cent, home-grown mixed hay 8.9 per cent and grass silage 12.6 per cent.

On the alfalfa ration the average daily consumption of dry matter was 33.2 pounds in Experiment 1 and 33.4 pounds in Experiment 2, an average of 33.3 pounds. The cows consumed 96 per cent of the dry matter fed. On the home-grown mixed hay and silage ration the average daily consumption of dry matter was 26.1 pounds in Experiment 1 and 26.3 pounds in Experiment 2. This was 78.6 per cent as much dry matter as was consumed by the group of cows receiving alfalfa hay. The cows on this ration consumed 95.1 per cent of the dry matter fed.

On the alfalfa hay ration the cows lost an average of .2 pound live weight per day in Experiment 1 and .4 pound in Experiment 2. On the home-grown mixed hay and silage ration the cows lost an average of .8 pound in Experiment 1 and 1.2 pounds in Experiment 2. The cows receiving alfalfa lost only 33 per cent as much live weight as the cows receiving the home-grown mixed hay and silage ration.

On the alfalfa hay ration the average daily production of four per cent fat corrected milk was 23.9 pounds in Experiment 1 and 24.5 pounds in Experiment 2. On the home-grown mixed hay and silage ration the average daily production was 22.0 pounds per day in Experiment 1 and 23.7 pounds in Experiment 2. This was 94.2 per cent as much milk as was produced by cows receiving the alfalfa. The average test was 3.5 per cent for cows fed alfalfa and 3.3 per cent for the cows fed the home-grown mixed hay and silage ration.

P16. Studies With Alfalfa Hay for Milk Production. I. R. JONES AND J. R. HAAG, Oregon Agricultural Experiment Station.

An exclusive ration of alfalfa hay allows good dairy cows to produce some 45 to 70 per cent as much milk and butterfat as when fed a normal ration. The production obtained on hay alone is affected by previous feeding and the quality of hay. The decline in production with the advance in lactation takes place at about twice the normal rate and continues rapidly even after the point is reached where the total nutrient intake is well above that supposedly required for the production of some 30 pounds of milk. The level of inorganic blood phosphorus is usually below normal but phosphorus supplements alone do not appear to materially arrest the rapid decline in production.

While it is true that cows cannot consume enough total digestible nutrients in the form of alfalfa hay for very high production, the precipitious decline in lactation is suggestive of a lack of protein stimulation. The deservedly high esteem in which alfalfa hay is held is based on palatability, yield and high protein content rather than on specific evidence of high biological value of its protein. The study deals in part with the influence of limited supplements of a mixture of equal parts of linseed, cottonseed, and peanut meals.

The feeding of as little as 2 or 3 pounds of the protein concentrate mixture at first arrested the rapid decline in production and then allowed it to proceed at a normal rate. These experiments indicate that the protein supplied by alfalfa hay alone may be an important factor contributing to a rapid decline in production. At the present time, similar studies are being conducted with single sources of protein.

P17. Comparative Yields of Louisiana Feed and Pasture Crops. R. H. Lush, Louisiana Agricultural Experiment Station.

Yields of various feed and pasture crops are compared in terms of hay equivalent, total digestible nutrients, calcium and phosphorus per acre where grown under similar conditions at five experiment stations in Louisiana. Coefficients of digestibility and of average composition, where not determined locally on crops other than pasture, are adapted from Morrison's "Feeds and Feeding," 20th Edition.

The highest yields of both hay equivalent and total digestible nutrients were obtained from mixed pasture at all locations except at Hammond, on flat wood land, where lespedeza fertilized with superphosphate out-yielded fertilized pasture in terms of nutrients, calcium and phosphorus, and at Calhoun, hill land, where well fertilized alfalfa was the highest yielding crop where grown, alfalfa or red clover produced the most calcium per acre, and at Calhoun the most phosphorus as well. In other locations fertile mixed pasture produced more phosphorus than any other crop, including the grain crops. This is important in the phosphorus deficient areas. Fertilized pasture at Hammond produced only 39.4 per cent more hay but 80.9 per cent more phosphorus per acre than the same kind of unfertilized pasture. Fer-

tilized lespedeza at the same station produced 2–3 times as much hay and 3–5 times as much phosphorus and calcium as untreated lespedeza.

The differences between good pastures and poor pastures within the state may be greater than between crops grown in the same location, however. The best alluvial land pasture at Baton Rouge produced 9985 pounds air-dried hay containing 5068 pounds total digestible nutrients, 56.8 pounds calcium and 36.4 pounds phosphorus. Unfertilized flat woods pasture 50 miles away produced only 2855 pounds hay, 1231 pounds total digestible nutrients, 10.9 pounds calcium, and 3.0 pounds of phosphorus per acre. While the calcium-phosphorus ratio above varies from 1.5 : 1 to 3.6 : 1 for the extreme kinds of mixed pasture, it is probably more desirable for cattle feeding than in other feed crops. A yield of 92.7 bushels corn per acre would supply as much total digestible nutrients as the fertile pasture above but only 38 per cent as much phosphorus and less than one per cent as much calcium.

Hay equivalent per acre is not a satisfactory comparative measure as the total digestible nutrients varied from 43.1 per cent on prairie soil, Crowley, to 54.3 per cent for fertile hill pasture, Calhoun. Alfalfa hay equivalent makes the above corrections for nutrients but assumes too much calcium and too little phosphorus for mixed pastures of Louisiana. Total digestible nutrients per acre is less subject to the above criticism, especially if mineral content is determined. Feed replacement values, dependent on feed prices and level of production, are also in error. Milk production, four per cent fat-corrected, per acre is probably more accurate.

This paper emphasizes the fact that improved pastures, regardless of the method of comparison, produce large amounts of well balanced dairy feed per acre in Louisiana as well as in other states. While costs are not included, it is believed that the pasture was a more economical source of feed as well as fitting better into a land conservation system.

P18. Pasture Yields as Measured by Clip Plots and by Grazing Dairy Cows. P. M. Brandt and H. P. Ewalt, Oregon Agricultural Experiment Station.

The yield from an area of 8.72 acres of mixed grass and Ladino clover pasture being grazed for the fifth consecutive season was simultaneously measured by the clip plot and grazing methods. The area was divided into four fields of approximately 2 acres each. The grazing practice was to rotate the cows often enough to enable them to graze to their maximum capacity. Under this system of management, each field was grazed 13 or 14 times during the season of 189 days.

The season was started with 15 cows, of which 8 were Holsteins, 3 were Ayrshires and 4 were Jerseys. As the season progressed, 3 cows were removed from the area to insure ample grazing for the others.

The carrying capacity for the season of 189 days was 12.43 cows or a total of 2351 cow days. The average initial weight per cow was 1020 pounds with an average daily gain for the season of 0.57 pounds. The average daily production per cow was 44.1 pounds milk and 1.45 pounds butterfat. According to the Morrison standard, the total digestible nutrient requirement was 23.44 pounds per cow daily and the amount supplied in the barn by concentrates was 8.13 pounds per cow daily. By difference it has been calculated that the pasture supplied 15.26 pounds of total digestible nutrients per cow daily or a total of 35,958 pounds for the 2351 cow days. The cows thus received 65.3 per cent of their feed requirements from the pasture.

Four one-hundred square-foot areas in each field were protected from grazing and clipped at the end of each grazing period. The yield of dry matter by the clip plot method from the 8.72 acres for the season was 54,194 pounds. Assuming the dry matter to contain 70 per cent of total digestible nutrients, the digestible nutrient yield has been calculated to be 37,936 pounds.

From the data given, the grazing method yielded 1978 pounds, or about 5 per cent, of total digestible nutrients less than the clip plot method. The difference of 5 per cent was obtained under conditions in which the barn was located adjacent to the pastures. In a previous study where the cows walked 4 miles daily to and from pasture, we obtained a difference of some 20 to 25 per cent in favor of the clip plot method.

It appears that under the conditions of this study, the clip plot method quite satisfactorily measured pasture yields.

P19. The Chemical Composition and Nutrient Yield of Pasture Grass Grazed at Successive Intervals During the Season. R. E. Hodgson and J. C. Knott, U. S. Bureau Dairy Industry and Washington Agricultural Experiment Station Cooperating.

The chemical composition, dry matter and nutrient yields have been determined on pasture for successive grazing intervals during each of the past three years. The five acre pasture was located on muck soil and was seeded in 1929. The predominating flora were Kentucky blue grass, English rye grass, meadow fiscue and a small amount of white clover. During each grazing period 20 cages were located over the pasture to protect the grass from grazing. After each grazing the grass was cut and the dry matter yields determined. The dry matter was composited and a representative sample analyzed for its nutrient content. Each grazing was started when the grass was in about the same stage of maturity. Cows grazed the pasture six times the first year, five times the second year and four times the third year. The days between the end of each grazing were considered the growing period for the grass.

Each year the dry matter content of the pasture grass was highest in mid-summer when the temperature was highest and the precipitation lowest. The protein content of the dry matter increased progressively as the seasons advanced, the range being from 12.7 per cent to 22.7 per cent the first year; 13.2 per cent to 23.4 per cent the second year and 12.1 per cent to 19.6 per cent the third year. The crude fiber and nitrogen-free extract content of the dry matter decreased progressively as the seasons advanced. The ether extract content increased slightly as the seasons advanced in the first and third year, whereas, in the second year it was higher during mid-season. The calcium content of the dry matter was higher during the drier and hotter part of the summer. The phosphorus content varied only slightly between successive grazing in each of the three years and no definite trend was observed.

The yields of dry matter, crude fiber and nitrogen-free extract decreased markedly as the seasons advanced. The ether extract, calcium and phosphorus decreased much less rapidly with advancement in the season, while because of the higher protein content of the dry matter, the yields of protein in 1936, particularly, were as great at the end of the season as earlier. The variation from year to year in total yield of dry matter and nutrients did not necessarily vary with total precipitation during the growing period (considered from April 10 to October 20).

P20. Some Relations of the Roughage Intake to the Composition of Milk. E. B. Powell, Ralston Purina Company, St. Louis, Mo.

During the past thirteen years the Purina Mills Experimental Farm has conducted a series of experiments to determine some of the relations between roughage consumption and variations in milk composition. This series of tests has involved 37 cows, mostly Holsteins, for a total of 85 lactations.

These experiments have shown that the fat content of milk was varied at will, as much as 60 per cent, by regulating the physical characteristics and total intake of the roughage part of the ration. This was done at will and without materially changing the quantity of milk produced.

The results further show that a cow may be maintained at the low fat level for at least three complete lactations without any apparent physical injury and can then be brought back to the normal fat percentage permanently by changing the physical characteristics of the roughage received and/or the amount of roughage received. The solids-not-fat also vary in the same general manner as the fat.

There is apparently a positive correlation between the activities of the rumen and the composition of the milk produced. We believe that the results of this series of tests show conclusively that the ration the cow receives does influence the per cent of fat in the milk, also the per cent of solids-not-fat and that these changes persist as long as the type and composition of ration is continued unchanged.

Some later work, still in progress at the Purina Mills Experimental Farm, indicates that the physical condition of the roughage and its quantity are not the only factors involved, but that the physical condition of the cow at freshening time and the composition of the concentrate used may have some bearing on the results secured.

In order to determine definitely whether or not rumination is an essential process for the production of milk of normal composition, we have removed the rumen from some dairy heifers at the Experimental Farm. These heifers will be grown out to maturity and will be used for further study on this problem.

P21. The Influence of Certain Rations and Management Practices on the Rate of Growth and Production of Holstein-Friesian Heifers.* H. A. HERMAN AND A. C. RAGSDALE, Missouri Agricultural Experiment Station.

This study is concerned with the effects of feed intake and the length of the growth cycle on the size and maturity of Holstein heifers at breeding and freshening time. The effects of rapid growth, high protein diets, and early breeding as reflected in milk production is included as a part of the investigation. This paper summarizes to date the influence of three rations on the rate of growth of Holstein heifers. The rations used consist of (1) milk and alfalfa hay supplemented only with salt and steamed bone meal; (2) a ration called "rapid growth ration" rich in vitamins and minerals and containing 27 per cent crude protein of high biological value; and (3) the rapid growth ration supplemented with 10 per cent of dehydrated cereal grasses. In addition the heifers receiving rations 2 and 3 were allowed 10 to 20 pounds of whole milk (3½ per cent fat) daily. The calves receiving Ration I were fed skimmilk after 9 weeks of age. All dry rations were fed *ad libitum*. Growth was measured by body weight and height at withers and compared to the "normal" as set forth in Missouri Agricultural Experiment Station Bulletins 336 and 338.

The heifers receiving Ration I (chopped alfalfa and skimmed milk) were 13.8 per cent below normal in body weight and 3.8 per cent below normal wither height at 2 years of age. The average freshening age was 28 months. This group was fed *only roughage* consisting of alfalfa hay, corn silage, and limited pasture, and produced an average of 6602 pounds of milk and 256.3 pounds of butterfat the first lactation, which averaged 333 days. A group of normally raised heifers of similar breeding fed the same roughages and grain at the rate of 1 pound for each 4 pounds of milk they produced, averaged 10,198 pounds of milk, 371 pounds of butterfat in 330 days, age 29 months. The sole roughage group averaged 69 per cent as much butter-

* Contribution from the Dept. of Dairy Husbandry, Mo. Agricultural Experiment Station, Journal Series No. 610.

fat as the control group. During the second lactation grain is being fed at the rate of 1 pound for each 6 pounds of milk produced daily. An increase in milk and fat production of approximately 35 to 40 per cent above that obtained on a roughage diet is indicated. Part of this increase of course is attributed to advancing age. The heifers in this group have grown slowly since freshening as 2 year olds. At 3 years of age they averaged 1033 pounds in weight (11 per cent below the standard and were 5 per cent below normal in wither height). They have, however, been unusually hearty eaters, regular breeders, and have suffered no udder troubles.

The heifers fed rations 2 and 3 were similar in growth and at 12 months of age were 30 per cent above normal in weight and 4.7 per cent higher at the withers. Since at this age the body weight and size closely approximated an 18 months old heifer, the heifers in this group were bred so as to freshen from 20 to 24 months of age. The average freshening age was 22½ months. In spite of the loss of weight following calving the heifers in this group averaged 1155 pounds at 24 months, 9 per cent above the growth standard and were 1 inch higher at the withers than normal. In production their showing has not been spectacular, the group of five has averaged 6488 pounds of milk, 245.4 pounds of butterfat in 271 days, age 22½ months. They have been fed the regular ration of sorgo or corn silage, alfalfa hay, pasture, and grain mix as is normally alloted cows in the University herd. Since freshening their growth has continued at a normal rate of gain.

From the standpoint of inherent ability the heifers should produce as well as the normal group, but it is obvious they will fall below this level. This factor, aside from the fact that more animals are needed in the experiment, may possibly be contributed to the fact that the heifers were not more mature at freshening. There is also the possibility advanced by many breeders that too heavy feeding of the heifer results in a mediocre producer as a cow. This problem is being investigated further.

P22. Vitamin A and Carotene in Relation to Growth and Well Being of Heifers. R. E. Ward and S. I. Bechdel, The Pennsylvania State College.

Three feeding trials were conducted with dairy heifers fed hays of low carotene content over the winter feeding period. These trials were designed to show any effect that increasing the carotene or vitamin A intake would have on the growth and well being of the heifers. Timothy hay of low grade with only 3 to 7 micrograms of carotene per gram and concentrate mixtures low in vitamin A were used as basal rations. The majority of heifers were on pasture during the summers prior to and subsequent to the feeding trials.

In the first trial twelve heifers were divided into two evenly balanced groups and fed for 150 days. One group received two pounds of alfalfa molasses silage daily per head and the other group received 0.3 pound of

soybean oil meal to make the rations comparable. The heifers receiving the soybean oil meal gained an average of 13.2 pounds more per head during the experimental period than those fed the alfalfa molasses silage.

In the second trial conducted over a period of 149 days four heifers received the basal ration only while four similar heifers received 4.5 grams of fortified cod liver oil per head daily in addition. These heifers were younger and had but limited access to pasture the previous summer. The group receiving the fortified cod liver oil made 6.3 pounds per head better gains than the group receiving the basal ration only.

In the third trial seventeen heifers were fed over a 72-day period. One group was fed a fifteen pound daily allowance of alfalfa molasses silage to each animal. The other group was fed similarly a 15 pound daily allowance of corn silage. The heifers receiving the alfalfa silage made 2.5 pounds better daily gain per head. This gain is probably due to the higher protein intake rather than to the increase in carotene.

A study of the breeding data on the heifers used in these trials show no appreciable differences in the number of services required for conception or on the health of the calves. The general health of the heifers appeared to be similar in all groups. Under the conditions of these trials it appears that carotene or vitamin A supplements will promote little or no increased growth or improved well being over a winter feeding period if hay of low quality is fed when the heifers have been on pasture during the previous summer.

P23. Carotene Changes in Natural Cured, Artificially Dried and Ensiled Roughages. O. M. Camburn, H. B. Ellenberger and G. C. Crooks, Vermont Agricultural Experiment Station.

Alfalfa, red clover and timothy crops of 1938 were preserved by ensiling alone, with molasses and with phosphoric acid, and by making sun cured and artificially dried hays. Each lot of silage was sampled when ensiled and again when removed for feeding. The hays were sampled when cut, when stored, and after 60, 120 and 180 days of storage. The carotene content of each sample was determined.

When cut, the second crop alfalfa carried twice as much carotene, 294 gamma per gram of dry matter, as did the first cutting alfalfa, timothy, or clover.

Carotene was preserved most satisfactorily by artificial drying. Little was lost in the drying process and there was about 70 per cent retention after six months storage. The silages retained nearly twice as much carotene as did the sun cured hays, 47 and 24 per cents respectively. One method of ensiling was not outstandingly better than another for retaining carotene.

After about six months of storage the sun cured hays had lost three-fourths, the silages one-half and the artificially dried hays about one-fourth of the carotene content of the green crops.

P24. Some Effects of Feeding Vitamin A and Carotene to Cows, on the Composition of their Milk and Blood. C. H. WHITNAH, W. J. PETERSON, H. W. CAVE, AND F. W. ATKESON, Kansas Agricultural Experimental Station.

In the first test twenty cows of four dairy breeds were studied. Blood from each cow was tested for carotene. A three-day composite sample of milk from each cow was tested for fat, lactose, protein, ash, calcium, phosphorus, and the color, refractive index, and melting point of the fat. The average daily yield for the three test days was also determined. After these tests, nine of the cows were fed a vitamin A concentrate for twenty days. The other cows were used as controls. The tests on blood and milk were repeated at the end of this period. A carotene concentrate was then substituted for ten days for the vitamin A supplement to the first group of cows. The milk constituents were again analyzed at the end of this period.

In a second test, three groups of ten cows each were matched as to breed and stage of lactation. The second and third groups were also matched as to milk flavor. They are the cows discussed in the following paper. Cows of the first group were fed another vitamin A concentrate similar to that used in Test 1. Cows of the second group were fed a more concentrated fish oil at a higher level, and mixed with the feed fresh daily. Cows of the third group were used as controls. After this feeding test had run twenty days, the daily carotene intake of each cow in all groups was increased about 0.45 gram by a change from low quality alfalfa to high quality alfalfa. In addition, each cow of group 2 was fed 0.30 gram of carotene as the concentrate used in Test 1. Four days were used as a transition period and the test was then continued ten days. Milk and blood tests were completed just before the feeding test and after ten, twenty, and thirty-four days.

Vitamin A fed as the fresh oil apparently increased the fat content of milk, while the oil which had been stored as an emulsion lowered the fat test. All the oil supplements increased the refractive index of the butterfat, but none of them greatly changed the melting point.

P25. The Effect of Feeding Vitamin A and Carotene to Cows on the Flavor of Their Milk. H. W. CAVE, W. H. MARTIN AND G. H. BECK, Kansas Agricultural Experiment Station.

The purpose of this experiment was to study the effect of feeding vitamin A and carotene to a selected group of cows on the flavor of the milk which they produced. Twenty cows representing four breeds were selected and

divided into two lots. Lot I served as a control and received the regular ration plus 10 grams of molasses daily per cow. Lot II was fed 300,000 I.U. of vitamin A daily per cow in 0.6 gram of oil prepared by the Hickman process. Each cow's allowance of oil was homogenized in 10 grams of molasses before feeding.

After twenty days of feeding to Lot II the vitamin A supplement was discontinued and a carotene concentrate containing one-sixth gram of carotene per pound was fed. For the first four days 0.2 pound per cow daily was fed. This was then increased to 2 pounds daily and was continued at this level for 10 days.

Samples of the fresh milk, three day old milk, and three day old pasteurized milk with and without added copper (0.5 p.p.m.) were scored by three judges at the start and at five day intervals throughout the experiment.

The mean scores of the fresh milk for Lot II at the start of the experiment, at the end of 20 days of vitamin A feeding, and at the end of 14 days of carotene feeding were 21.8, 21.8 and 22.25 respectively; and for the control cows were 21.1, 20.5 and 21.1.

The mean scores of the stored milk from Lot II for each of the three observation periods were 18.7, 19.65 and 21.25 respectively; and for the control group were 19.5, 19.4 and 19.45.

The mean scores for the stored pasteurized milk from Lot II were for the three observation periods 20.2, 20.5 and 21.2 respectively; and for the control cows were 19.8, 19.4 and 20.1.

In Lot II the average scores of the stored pasteurized milk to which copper had been added were, for the three observation periods, 15.0, 17.9 and 18.8 respectively; and for the control group were 16.1, 15.4 and 16.4.

Special attention was given to the development of oxidized flavor in the milk from the two groups of cows. At the start of the experiment 30 per cent of the cows in the fed group and 20 per cent of the cows in the control group gave milk that developed an oxidized flavor. The feeding of vitamin A did not change materially the frequency with which the oxidized flavor occurred in the milk of Lot II cows. After the carotene was fed none of these cows produced milk which developed oxidized flavor, while 20 per cent of the cows in the control group continued to produce the off flavored milk.

The feeding of 300,000 I.U. of vitamin A per cow daily did not materially improve the flavor of the milk, neither did it protect the milk against the development of an oxidized flavor. However, in the milk to which copper had been added there was some reduction in the intensity of the oxidized flavor. When carotene was fed there was a noticeable improvement in flavor and the occurrence of oxidized flavor was entirely eliminated in the fresh and in the stored untreated milk.

P26. Anatomical and Physiological Changes in the Pituitary Gland in Vitamin A Deficiency. T. S. SUTTON, Ohio State University.

The pituitary glands of white rats were studied in an attempt to determine the *modus operandi* of vitamin-A deficiency in the production of sterility.

The application of histological methods showed a significant increase in the "basophilic" cells in the hypophyses of vitamin-A deficient rats of both sexes. This increase in basophil count was greatest in the males. The anatomical changes observed were of sufficient magnitude that it was felt that an assay for gonadotropic substance should show differences in physiological activity.

A sensitive technique for the assay of gonadotropic activity was devised. By employing this technique, anterior pituitaries were assayed for gonadotropic activity. The data obtained show that pituitary substance from normal males has greater gonadotropic activity than that from normal females. In vitamin-A deficiency, the gonadotropic hormone content of the pituitary is increased. This increase in potency is greater in the male than in the female. The sensitivity of the technique is illustrated by the fact that 0.14 mg. of anterior pituitary substance gives a measurable stimulation.

This study provides evidence that a vitamin-A deficient diet causes direct damage to the gonad, the increase in basophilic cells and gonadotropic potency represents compensatory changes in the anterior pituitary.

P27. A Field Study of the Influence of Restricted Winter Rations on the Blood Calcium, Phosphorus and Carotene of Dairy Cattle. W. H. Riddell, F. W. Atkeson, W. J. Peterson and W. W. Thompson, Kansas Agricultural Experiment Station.

The cumulative effect of successive dry years together with rations from restricted plant sources has been reflected in the thrift, yield and reproduction of many herds in the Central Plains area. This past year in Kansas there was little or no pasture available since summer. In normal years wheat pasture is usually available in the state throughout the fall and part of the winter. With the supply of alfalfa hay also limited in the state, a majority of farms depended largely on carbonaceous roughages, principally the sorghum fodders. Furthermore, on many of these farms the amount of protein supplement fed was limited or none at all.

Research elsewhere has shown that forage crops are lower in available phosphorus in a dry year. Also the carotene content of dry roughages is notably less than in pasture or green leafy hays. The principal object of this field study was to determine the effect that lack of pasture and feeding low grade roughage had on the blood picture, particularly with reference to the calcium, phosphorus and carotene levels.

One hundred fifteen samples were collected on the 36 farms in representative sections of the eastern two-thirds of Kansas. These farms were typical of feeding practices followed in many herds in Kansas this past fall and

winter. Calcium, phosphorus and carotene were determined on the blood serum less than 24 hours old.

The following average values were obtained:

Calcium	10.55	mgms./100	cc.,	range	8.8	–13.2	mgms.
Phosphorus	5.35	"	"	",	"	2.0	–10.3	"
Carotene	0.394	"	"	",	"	.018–	1.57	"

Except where symptoms of abnormal appetite had been reported recently, the condition of the animal was no index of the mineral level in the blood. In several instances where a herd because of general lack of thrift was thought to be an excellent prospect for low mineral values, the reverse was found to be true. Apparently the level of production in such herds was at such a low level as to constitute little drain on the mineral reserves of the animal.

On the other hand the quality of the ration was directly reflected in the blood carotene. Generally speaking, the animal's condition was a good index of its carotene intake.

Although many of the rations were deficient in protein and in some cases total nutrients, the outstanding finding was the extensive need for vitamin A as reflected by abnormally low blood carotene values.

P28. Rickets in Calves, A Regional Problem. A. H. KUHLMAN AND W. D. GALLUP, Oklahoma A. & M. College.

The manner of supplying vitamin D in the ration of dairy calves for most efficient utilization of calcium and phosphorus and the prevention of rickets has been the subject of recent investigation. Much of the early work on this subject was done with calves maintained in semi-darkness and receiving a basal ration of high Ca or P content. The experimental conditions imposed were favorable to the development of rickets and may not be considered as normal.

In view of the abundance of sunshine in certain of the southern states, the need in these localities of specific vitamin D supplements in calf rations has not been emphasized. It is recognized that in such regions under ordinary conditions of feeding and management, calves probably receive sufficient amounts of vitamin D to meet their daily requirements. Only after restriction of calves to a simplified ration with limited exposure to sunlight have the symptoms of vitamin D deficiency and rickets appeared. In studies at the Oklahoma station, calves have been raised on a ration of cottonseed meal and molasses beet pulp with supplements of bone meal and vitamin A. Unless exposed to direct sunlight or given vitamin D supplements, these calves developed rickets of varying degrees of severity. Prairie hay when fed ad libitum in place of beet pulp has protected the calves against rickets.

The calves from birth were raised in individual pens in a wing of the dairy barn which has liberal window exposures on the east, south, and west.

During fair weather, large double doors on the south and windows on the east and west were kept open during the day. Determinations of blood Ca and P were made at regular intervals to follow the course of rickets. The calves received outside exposure or vitamin D supplements only after a rachitic condition was established. The vitamin D supplements employed were "aerated" and plain codliver oil, viosterol, and prairie hay.

Blood calcium values dropped from 9–12 Mg. per 100 Ml. of plasma to 8 Mg. preceding the addition of vitamin D supplement. Blood P values were in many instances unaltered. External symptoms of rickets were evident.

Normal blood calcium and phosphorus values were restored within a week after outside exposure to sunlight even during the winter months or following the addition of vitamin D supplements. No cases of rickets developed among the calves fed prairie hay.

Detailed results in mimeographed form are available.

P29. Further Studies on the Vitamin D Deficiency of Mature Dairy Cows. G. C. WALLIS, So. Dak. Experiment Station.

Experimental studies establishing the fact that liberal-milking dairy cows have a definite vitamin D requirement which must be satisfied if the animal's health and vigor are to be maintained have been previously reported from this station. Continuous investigational work in this general field has revealed additional information which will be discussed in this paper in a preliminary way.

1.—The possibility of determining the concentration of vitamin D in the blood plasma and using this information to indicate the degree of deficiency or sufficiency of this factor in the animal's body has been investigated. The results give promise that this technique may prove to be a very useful and sensitive device to use in connection with vitamin D deficiency investigations and other studies such as the vitamin D requirements of animals and the value of various vitamin D carriers as sources of this factor. For example, cows receiving an alfalfa hay and grain ration have shown about 1.25 to 1.50 International Units of vitamin D per cc of blood plasma, whereas cows that were markedly deficient in vitamin D as measured by other criteria showed only traces of vitamin D in the blood plasma.

2.—The rate at which milk is produced is an important factor in determining the rapidity with which a vitamin D deficiency condition is produced. Some cows on this experiment have produced up to 60 or 65 pounds of milk per day and have shown definite symptoms of a vitamin D deficiency in the comparatively short time of 3 or 4 months, whereas cows giving less milk have become depleted only after the lactation was nearly completed. To represent the extreme condition, a dry, barren cow is being carried along under vitamin D deficient conditions.

3.—The antirachitic action of late August and September sunshine was found to be very effective in overcoming the vitamin D deficient condition of one of the animals on this experiment. This is significant in view of the fact that one group of workers who used an entirely different approach to the problem, have previously reported that milking cows were unable to utilize the antirachitic action of sunshine.

4.—Observations have also been made on such other problems as the ability of an increased calcium and phosphorus intake to relieve vitamin D deficiency conditions, the value of alfalfa hay as a curative agent, the quantitative requirements of cows for vitamin D, the possibility of vitamin D reserves being lost through excretion into the intestinal tract, and the mineralization of the skeleton of calves born to vitamin D deficient cows as indicated by chemical analysis of the sixth ribs.

P30. Vitamin E Studies with Male Rats. A. O. Shaw, Ella Woods and J. O. English, Idaho Agricultural Experiment Station.

In an attempt to determine the relationship of vitamin E containing feeds to fertility in males, studies were carried on with male rats in the nutrition laboratory at the Idaho Agricultural Experiment Station.

Young male rats when weaned at 21 days of age were placed on the Evans and Burr E-low diet or on this diet plus the supplement to be studied.

When the male rats were not less than 60 days of age, an estrous female of proved fertility was offered each male at approximately weekly intervals. On the following morning residual vaginal spermatozoa were sought in these females and in all cases of sexual congress the fate of the gestation was followed. After three consecutive matings in which sexual congress was evident but no gestation occurred, a different female was used in order to keep the responsibility of failure with the male. The females were kept on the laboratory stock ration both before and after the matings.

The male rats kept on the vitamin E-low diet unsupplemented grew well for 4 or 5 months after which growth continued at a much slower rate and the animals developed a generally disheveled appearance. Forty-six young from eight fertile matings resulted from 13 animals in 232 positive matings.

The results from feeding pea germ meal in amounts up to 3 grams per rat per day, whether used to regenerate fertility at 60, 70, or 80 days of age or used to develop it by feeding from 21 days of age, were no better than from the E-low diet only.

Male rats were fed wheat germ oil in doses ranging from 2 drops per week to 20 drops per day. Those animals which received wheat germ oil up to one drop per day for 7 days a week showed no improvement in fertility over those on the E-low diet only.

Six rats receiving 5 drops of wheat germ oil per day showed 18.8 per cent fertile matings out of 101 trials and 5 rats receiving 10 drops of wheat

germ oil daily showed 26 per cent out of 76 trials. However, 3 animals fed 20 drops of the same oil per day showed only 13 per cent fertile matings out of 53 trials.

Histological studies of representative animals from these groups are being made.

P31. Are Urea and Other Simple Nitrogen Compounds Useful in Dairy Cattle Feeding? E. B. HART, G. BOHSTEDT, H. J. DEOBALD, M. I. WEGNER, University of Wisconsin.

The utilization of simple forms of nitrogen in animal nutrition, particularly by ruminants, has been of interest to European more than American investigators. At the University of Wisconsin urea and ammonium bicarbonate have been under investigation the past two years.

The basal ration mixtures for dairy calves in two experiments, each lasting nearly one year, were made up of ground yellow corn, ground timothy hay, starch, corn molasses, steamed bone meal, iodized salt, and cod-liver oil. This basal ration furnished a little less than 6 per cent total protein ($N \times 6.25$) and, therefore, too little for normal growth. Other rations had casein added to raise the protein content of the mixture to 18 per cent. To still other rations, urea or ammonium bicarbonate was added to raise the nitrogen to the same level as that of the casein ration. Urea was also fed at two lower levels. It thus supplied from about 43 to 70 per cent of the total nitrogen of the several rations.

The actual additions to each 100 pounds of the basal ration mixtures were 1.4 pound, 2.8 pounds, and 4.3 pounds urea; 11.1 pounds ammonium bicarbonate; and 11 pounds casein. The plan was to equalize the feed intake to the lowest individual consumption.

Growth on the ration containing the lower level of urea was nearly as rapid as on the casein ration and considerably more rapid than on the higher levels of urea or ammonium bicarbonate. The higher levels of urea proved to be diuretic in their effect. The simple nitrogen compounds were utilized under all conditions although not to the same extent as the protein casein.

Growth records and analyses of blood and other body tissues proved that the simple forms of nitrogen were built into body protein. Only the high urea (diuretic) ration resulted in hypertrophy of kidneys. Those of calves on the low urea ration were entirely normal.

Samples of rumen content of 3 calves fed low urea, high urea, and casein, showed a pH of 7.8, 7.6, and 7.8, respectively. Bacterial cultures revealed no essential qualitative difference.

Where in rations of other ruminants urea used as the only source of nitrogen has resulted in practically no storage of nitrogen, it appears that urea nitrogen may be utilized to a considerable degree when making up

only part, in this case about 40 per cent, of the total nitrogen of the ration. Apparently the urea or ammonium bicarbonate nitrogen is first converted into bacterial protein through the intervention of paunch organisms and subsequently digested as protein in the true stomach and intestines.

Some of the practical aspects of the problem are the utilization of ammonium compounds and other simple forms of nitrogen frequently found in legume silage, and the considerable proportion of non-protein nitrogen found in heavily nitrogen fertilized pasture.

P32. The Relation of the Rate of Disappearance of Milk Curd from the Calf's Abomasum to the Apparent Digestibility of its Protein. H. C. Dickey, Dwight Espe and C. Y. Cannon, Iowa Agricultural Experiment Station.

It has usually been assumed in the studies of the digestibility of milk that the more rapid, and possibly, easier passage of the curd from the stomach indicated a superior and more highly digestible milk. The present work is an attempt to determine the effect of the rate of evacuation of the stomach on the coefficient of digestibility of the protein in the ration. Fat-free milk (separator skim milk) from a selected group of Jersey cows was used in each trial. In the first series of experiments the time for the unaltered hard curd skim milk to pass through the entire intestinal tract of young calves was determined by means of a feces marker (carmine). Soft curd skim milk was fed during alternate trials and comparable data obtained. The soft curd milk was prepared by preheating the hard curd milk to 180° F. (82° C.), cooling to 150° F. (66° C.) and homogenizing at 2500 pounds pressure. Curd tension was determined on each batch of milk used. The average curd tension of the hard curd milk was 142 grams, measured by a modification of the Hill method, while the soft curd milk had an average curd tension of 40 grams. Throughout each feeding trial water, minerals, and cod liver oil were fed in appropriate amounts in addition to the milk.

The milk being tested was fed for a period of 32 hours before the feces marker was given. The results showed that there was no significant difference in the time required for the carmine to make its appearance in the feces when given with the hard curd skim milk as compared with the soft curd skim milk. However, a statistically significant correlation was obtained which showed that as the pounds of milk fed were increased, the number of hours required for the passage of the milk through the gastro-intestinal tract was decreased.

A series of trials, using calves prepared with rumen fistulas, tested, in alternate trials, the rate of evacuation of the two types of curd from the abomasum. The milk, warmed to 37° C., was fed, a liter at a time, through

a ¼-inch rubber stomach tube inserted into the abomasum of the calves by way of the rumen fistula and the reticulo-omasal orifice.

It required an average of 9½ hours for the curd from one liter of high tension milk to be liquefied and escape from the abomasum, while that from the soft curd milk required 6¾ hours.

Seven pairs of rats, paired according to age, sex, litter, weight, and amount of milk consumed, were used to determine the coefficient of digestibility of the proteins of the hard and soft curd milks. The seven-day digestion trials, preceded by a three-day preliminary period, showed little difference in the digestibility of the two milks. Trials are now under way with calves to determine the coefficient of digestibility of the proteins in these two types of milk.

P33. Factors Affecting the Reactions of the Esophageal Groove of Dairy Calves. GEORGE H. WISE, South Carolina Agricultural Experiment Station.

A preliminary study, by visual inspection and by palpation of the esophageal groove of fistulated calves, has been made in an effort to discover some of the factors affecting the reaction of this groove. In accord with observations of other investigators consumption of milk, either by nursing or by drinking from open pail, caused the groove to contract and to function as a conduit from cardia to omasum. Filling the rumen with milk via the fistula did not affect the tonicity of the groove, indicating that the reflex does not originate at the distal extremiy of the esophagus.

Drinking tap water usually stimulated the esophageal groove to functional activity in the calf less than three or four weeks of age, after which the response began to subside finally becoming nil. The consumption of a grain mixture, chopped alfalfa hay, chopped *Lespedeza sericea* hay, steamed bone meal, common salt and cod liver oil, respectively, failed to initiate any reaction on the part of the groove.

Generally, the act of sucking stimulated closure of the esophageal groove as evidenced by its response in calves sucking a clean nipple. Thus in nursing both the sucking and the milk apparently stimulated the groove to activity.

In the class of psychic responses may be listed the effects of sight of milk at feeding time and fright immediately preceding feeding. In a calf about a month of age, a view of the milk caused the muscularis of the groove to contract strongly. As the calf become older, the response waned. On the contrary, as noted in only one calf, fright shortly before feeding milk prevented the groove from responding to the stimulus of milk. This was consistently repeated in the one calf but could not be duplicated in any one of six other calves.

P34. Artificial Insemination of Dairy Cows.* H. A. HERMAN AND A. C. RAGSDALE, Missouri Agricultural Experiment Station.

Artificial breeding of dairy cows is being practiced at present in nearly one hundred Missouri herds. The greater portion of these herds are included in three cooperative breeding organizations, although several large breeding establishments are using the method to a good advantage. In connection with this program it has been possible to amass some data on the relative efficiency of natural and artificial breeding as well as factors affecting the fertility of stored semen.

Semen collection has been largely by means of the artificial vagina, but in several instances where crippled bulls have been concerned the collections have been made by massaging the ampullae. Most of the semen has been used the same day it was collected, but in connection with some phases of the project the semen has been cooled and stored at 40–45° F.

The University of Missouri herd has been divided into two groups, one-half the cows being bred artificially and the other half naturally. A study of breeding efficiency in this herd covering the past 25 years, and entailing the use of 21 bulls, reveals that 1197 services were required to produce 785 calves, or 1.5 services per conception. This is considerably lower than the average reported by many investigators. Many of the bulls were proved sires from 9 to 15 years of age, but the herd has always been remarkably free of vaginitis and Bang's disease. The bulls ranged from 1.07 to 2.00 services per calf.

In the case of 65 cows in the University herd successfully settled since February, 1938, 32 have been artificially bred. Four of these were considered shy breeders and had been bred from two to four times to the bull before artificial insemination was attempted. The average insemination, by artificial means, required for conception by the cows considered regular breeders was 1.4. The 36 cows naturally bred required 1.56 services. The four difficult breeders were finally settled by artificial means and required from two to four services. These were usually inseminated twice each estrus period, the first insemination being made about the middle of the heat period, and the second 6 to 10 hours later.

In cooperation with the Farm Security Administration, Hughesville, Missouri, an artificial breeding project involving 32 farms and approximately 350 Jersey cows has been in progress the past year. Approximately 250 cows have been artificially bred with an average of 1.8 services. Semen transported 75 miles and held from 3 to 6 hours before use gave a much lower efficiency than semen freshly drawn and used within 1 to 2 hours. The sires used were all highly fertile and were producing spermatozoa of normal morphology and in great concentration.

* Contribution from the Department of Dairy Husbandry, Missouri Agr. Exp. Sta., Journal Series No. 609.

Semen stored 18 days at 40 to 50 degrees F. showed approximately 90 per cent motility, but it has thus far been impossible to secure conception with semen stored more than 48 hours and in these instances only two out of seven cows thus bred have been pronounced safe in calf. Studies on this phase of the problem are being continued.

P35. The Inheritance of the Condition for a White Head in Holstein-Friesian Cattle. LESTER O. GILMORE, WM. E. PETERSEN AND J. B. FITCH, University of Minnesota.

Increased knowledge of color inheritance in cattle is associated with a revival of interest in attempts to associate color genes with those responsible for function, structure and with the further attempt to verify authenticity of registration. Beginning the study at Kansas, Ibsen has pointed out the distinction in the conditions occurring in Holstein and Herefords, although the appearance of the head in the two cases is similar. In 1933, Minnesota joined in the study, the results of which are here summarized. The details for both the Kansas and Minnesota findings are planned to be published concurrently.

Positive identification of this pattern is sometimes difficult because of the lack of pigmentation on the body, a condition thought to be related to decreased pigmentation on the head. Thus a "white headed" animal that is largely white may have small pigmented areas close to the eyes because of the presence of complicating genes for distal black are epistatic to dominant whites in general. Another difficulty in identification comes from the presence of the same genes for black on animals otherwise containing but little white. This latter combination may result in animals appearing somewhat as though they had a blaze.

The "white head" pattern was found to be present on 8.6 per cent of 94 animals in a herd containing transmitters of the responsible gene as compared to a 5 per cent frequency in a population of 3655 animals included in a group selected for comparison. This group included all animals whose picture appeared in the Holstein-Friesian World in all issues from 1910–18 and 1924–25.

The results indicate that the condition for the "white head" pattern is dominant or epistatic to other head patterns that are uncomplicated by genes affecting color on distal areas. This conclusion results from a consideration of both parents of 31 "white head" individuals as well as pictorial pedigrees of "white heads." It was found that "white head" individuals have at least one "white head" parent and that for some individuals the presence of the pattern can be traced in this manner through at least nine generations.

Most of the "white heads" studied were traced back to Hengerveld De Kol or to a closely related ancestor. The possibility exists that if all "white

heads'' studied had been traced further they, too, would have been found to trace in direct line to a common ancestor.

P36. The Inheritance of Fertility in Dairy Cattle. ARLESS SPIELMAN AND I. R. JONES, Oregon State College.

Animal breeders have long been of the opinion that families and breeds of livestock vary greatly in their inherent capacity for reproduction. The belief that these differences are due to the presence and expression of genetic factors is indicated by a review of the literature dealing with fertility in Drosophila and other species.

A study was undertaken to determine if genetic factors affecting fertility have been operating in the dairy herd of 368 cows maintained by the Oregon State Agricultural College during the past 25 years.

Fertility in the dairy cow obviously depends on two factors, the frequency of reproduction, and the total number of successful gestations.

The per cent reproductive efficiency has been proposed in an earlier study by the authors, as a measure of the frequency of reproduction. In the study reported, a significant difference was found in the mean per cent reproductive efficiency among cow groups and between breeds.

A correlation of $r = +.546 \pm .118$ between the reproductive efficiency of the foundation cows and the mean reproductive efficiency of their respective female descendants was obtained.

A ''longevity-of-fertility'' rating is proposed as an expression of the number of successful gestations which a dairy cow undergoes. A significant difference in the longevity of fertility among the four breeds studied was observed. The values were as follows: breed No. 1, 32.56 ± 3.19; breed No. 2, 36.47 ± 5.53; breed No. 3, 63.52 ± 7.35; breed No. 4, 25.54 ± 4.37.

Correlating the per cent reproductive efficiency with the ''longevity-of-fertility'' rating, a significant value of $r = +.804 \pm .026$ was found. This close relationship suggests that the reproductive efficiency of a cow may be a good indication of the probable number of successful gestations which she may undergo.

Although a comparatively small number of animals were included in the study, it is believed that the high correlation values obtained indicate that inheritance is in part responsible for the great differences in fertility of dairy cows.

P37. Analyses of Dairy Herd Breeding Records. S. W. MEAD AND W. M. REGAN, University of California.

A diagrammatic method of presenting the history of reproduction in dairy herds, reported in the JOURNAL OF DAIRY SCIENCE for June, 1938, has been used in a study of the efficiency of reproduction in seven of the dairy herds cooperating with the University in its Jersey breeding experiment.

Complete breeding and calving records have been maintained continuously over periods of from six to ten years, during which time these herds have averaged 48 females of breeding age. All herds have been free of both Bang's disease and tuberculosis.

The analyses of the data have included, (1) a study of the average number of services required per pregnancy in each herd during each succeeding two year period, (2) the average number of services required for first pregnancy compared to all later pregnancies and, (3) the number of services required for first pregnancy, among heifers requiring three or more services, as compared to the number of services required by the same heifers for later pregnancies.

To obtain the average number of services for pregnancy during a two year period, the total number of services recorded during the period were divided by the total pregnancies occurring during the same period as determined by later recorded calvings. According to the method used in this study, four of the seven herds have had a reasonably good reproductive history over a period averaging eight years. These herds have averaged less than two services per pregnancy. The other three averaged 2.6 services. Each of these last three herds has experienced more difficulty with heifers being bred for first pregnancy than have the other four. In one herd over a period of eight years 57 per cent of the heifers have required three or more services for first pregnancy. Contrary to common opinion, all herds do not experience more breeding trouble with heifers being bred for first pregnancy than for later pregnancies. In only two of the seven herds have the heifers averaged more services for first pregnancy than for cows bred for later pregnancies. In all herds, regardless of the extent of breeding difficulty among heifers, our figures have shown that the heifers requiring three or more services for first pregnancy, required fewer services for all later pregnancies. At no time during the histories of the two herds experiencing most trouble with heifers being bred for first pregnancy did later pregnancies require as many services as first pregnancies.

P38. Increasing Production in Institutional Herds. A. L. Beam, C. S. McLearen, and A. A. Borland, The Pennsylvania State College.

Because there has been a substantial increase in the production of milk and butterfat in a number of state institutional herds during the last few years a survey of fourteen of these herds was made to determine the causes and the variation of this increase among the herds. It was hoped that through this study additional information could be obtained which might aid in maintaining or improving production in dairy cattle.

Data was gathered from each institution by a series of arranged visits at which times information was secured by questioning the herdsmen, by study-

ing the records available, and by inspecting the herds and facilities for dairying at each institution.

About 1,200 Holstein cows were included in these institutional herds at the time the survey was made. The size of these herds varied from 21 to 145 milking cows. All herds are entered in Dairy Herd Improvement Associations and uniform management records covering milk production, feed consumed, and breeding data are kept by each herdsman or farm manager. With the exception of a few years in several herds these records have been kept since each herd was established. A study of the records show that the production of milk for the herds as a whole has been increased from a little over 9,000 pounds of milk in 1929 to over 12,000 pounds in 1935. Since 1935 the average yearly production for all herds has not been less than 12,000 pounds of milk. During the last six years the average production among these fourteen institutional herds has ranged from 9,720 to 16,667 pounds of milk.

The preliminary findings indicate that the improvement has been too rapid to be attributed solely to breeding and selection. Evidence seems to point to the conclusion that management factors have had a marked influence on the increase in production. Careful culling, shortening the length of calving interval, disease eradication, and good management practices have had the major influences in increasing production for the herds as a whole.

Age of first calving, amount of culling, type of foundation animals, demand for milk by the institutions and prevalence of diseases are major factors affecting the variation of production between herds.

Disease eradication relative to breeding troubles has increased the average production of all herds. In 1932, 18 per cent of the cows in all herds required three services or more per conception. In 1937, only 12 per cent of the total number of cows required three or more services per conception. The herds having a lower average yearly production have had repeated outbreaks of Bang's disease and mastitis. The herd maintaining the highest yearly production has been free from Bang's disease and has had practically no trouble with mastitis.

The age of first calving at the institution having the highest yearly production over a period of years has been 32.5 months. Growing heifers out well before breeding has been practiced in this particular herd for the past twelve years. At several institutions with much lower yearly production it has been customary to have all heifers freshen at an average age of 27 months.

One very definite fact was brought out relative to the transmitting ability of related sires. In one institution fifteen daughters of one sire averaged 11,808 pounds of milk while their dams had an average production of 13,787 pounds. Seven daughters of this same sire in a private herd averaged 10,870 pounds of milk as compared with 19,566 pounds for the dams. All records have been converted to a mature basis.

In another herd a close relative of the above bull sired fifteen daughters whose average production was 21,239 pounds of milk. The dams of these daughters had an average production of 16,892 pounds.

This is further evidence that a bull's pedigree is not a safe measure of his transmitting ability. In large herds it would pay to prove a young sire before using him extensively.

P39. The Use of Various Oils and Fats for Calf Feeding. T. W. GULLICKSON AND F. C. FOUNTAINE, University of Minnesota.

The original object of the experiment was to determine whether some cheaper oil or fat can be used satisfactorily to replace butterfat in the diet of calves. The following were used: 1) soy bean oil, 2) corn oil (Mazola), 3) cottonseed oil (Wesson oil), 4) lard (Silver Leaf brand), 5) butter oil.

The experimental milks as fed were prepared by homogenizing each oil or fat into fresh skimmilk at 3,000 pounds pressure, single phase, to form a product containing 3.5 per cent fat.

Two to four calves were used in testing each skimmilk-oil product. For purposes of comparison, one calf was fed normal whole milk, and another, a ration designed to be almost fat-free.

The calves used were grades of Holstein and Guernsey extractions, males and females, and healthy and thrifty when placed on experiment. They were fed whole milk until about one week old, after which, excepting for the two calves mentioned above, the skimmilk-oil product was gradually introduced. From 20 to 30 cc cod liver oil (U.S.P.) was fed daily. Beginning at about 30 days of age a limited amount of a low-fat concentrates mixture was added to the diet. The calf on the fat-poor diet was fed a mixture of 2 parts dry skimmilk and 1 part glucose (Cerelose). All calves, except those fed lard, were fed on the same plane of nutrition. The latter were fed at slightly higher level.

Each calf was kept in a separate pen, fed individually, and weighed weekly. Blood fat was determined weekly.

Results. The calves consumed the diet prescribed. Indigestion appeared; the soy bean oil group being most seriously affected. Two of three calves in this group died by the 13th week. The third, weak and unable to stand by the 17th week, made remarkable recovery when fed whole milk. Average weekly gain per calf was 2.3 pounds.

One calf fed corn oil died within 10 weeks, gaining total of 15 pounds. Weekly gain of other two for 18 weeks about 3.25 pounds. Of the three calves fed cottonseed oil, one died the 12th week, total gain 13 pounds. Weekly gain of the others in 18 weeks, 2.75 pounds.

No differences were noted in appearance between calves fed whole milk and those given the homogenized skimmilk-butter-oil product. Average weekly gain of both groups, 18 weeks was about 8.5 pounds. The low-fat

diet calf was rough but gained nearly 5.5 pounds weekly. Lard-fat calves remained thrifty throughout. Average weekly gain about 5 pounds.

Many of the vegetable-oil-fed calves developed a dermatitis-like condition resembling that described by Burr occurring in rats on a diet low in linoleic acid. Blood fat varied widely but averaged lower in the low-fat and the soy bean oil calves and higher in the cottonseed oil and corn oil groups than in the calves receiving butterfat. Post mortems revealed no marked abnormalities except an almost complete absence of internal fat.

P40. The Influence of Fineness of Grinding on the Digestion Coefficients of Oats for Dairy Cows. G. C. WALLIS, T. M. OLSON, AND T. A. EVANS, So. Dak. Agric. Exp. Station.

The effect of the fineness of grinding on the digestion coefficients of corn have been previously discussed. A similar set of observations have been made on oats as it seemed quite possible that the results with grains protected by a heavy seed coat, or hull, might be different from those obtained from other grains, such as corn. Four cows in mid-lactation were used on these trials with oats. The investigation consisted of a series of four digestion trials using the four cows on each trial. Each trial consisted of a preliminary period of 7 days and a collection period of 14 days. The rations were adjusted to meet the average requirements of the cows for the entire experimental period of approximately 3 months, so there was no change in the quantity of any feed being used throughout the duration of the experiment. All the rations consisted of half by weight of alfalfa hay and half by weight of oats. The amount fed was adjusted to the average requirements for each cow and thereafter the only change was in the preparation of the oats. In the first trial medium ground oats were used; in the second, finely ground; in the third, whole oats; and in the fourth, alfalfa hay alone. In the third trial the feces were washed over a fine screen and the whole oats which had passed through the digestive tract were recovered. The amount of oats recovered in the feces varied from 11.57 to 19.91 per cent for the different cows. All the chemical analyses for this experiment have now been completed and the final results are being calculated at the present time. When these are available interesting comparisons between the results on corn and those on oats will be possible.

P41. The Effect of Changes in Environmental Temperature on Water Consumption of Producing Dairy Cows. W. M. REAGAN AND S. W. MEAD, University of California.

The effect of changes in environmental temperature on high producing dairy cows was studied in a large psychrometric room in which the temperature was increased from 40 to 100° F., while air movement and relative humidity were maintained at constant values of 50 feet per minute and 60

per cent, respectively. Data were taken on three pairs of Holstein cows for periods approximating three months. A standard diet of hay and concentrates was fed in accordance with individual production and appetite. Each cow was provided with an individual water bowl to which water was supplied through a carefully calibrated meter. Daily recordings were made of the feed and water consumption and milk production of each cow.

A study of these data fails to substantiate the general belief that the water consumption of dairy cows is materially increased in hot weather. Uniformly constant values were obtained for temperatures ranging from 40 to 80° F. The upper limit of heat regulation for producing Holstein cows is about 80° F. When the room temperature is maintained above this point for more than 24 hours, the animals tend to become hyperthermic, coincident with a reduction of feed and water intake and the milk "flow." Instead of an increase there is an actual decrease in the amount of water drunk at the higher temperatures.

It has long been recognized that there is a definite relationship between the cow's water requirement and her food consumption and milk production. When, in the study of our data, proper correction was made for the decline in food intake and milk production, there was only a slight correlation between room temperature and water consumption.

EXTENSION SECTION

E1. Community Dairy Cattle Breeding Plans. Report of Sire Committee, J. F. KENDRICK, *Chairman*, U. S. Bureau of Dairy Industry.

The general objective of all organized dairy cattle breeding programs is to improve dairy herds by making available at reasonable cost, continuous superior sire service for the herds of the greatest possible number of dairymen. Various types of organized dairy cattle breeding programs are at present being conducted in the United States. The cooperative bull association is one type of organization that is proving most successful when it is carefully organized and operated on a sound business basis. In recent years other types of organizations have been set in operation in the various States, all designed to fit the particular conditions under which they operate. The Sire Committee shall attempt to make a complete report on the various types of organizations now in existence, pointing out the apparent merits and weaknesses of each.

E2. Bull Studs in the Community Dairy Cattle Breeding Program. IVAN H. LOUGHARY, University of Idaho.

A community effort to obtain low cost, high quality bull service by herd owners agreeing to patronize a selected individual who purchases suitable bulls is a new program in Idaho. The group of bulls is called a bull stud.

It may be composed of bulls of several breeds. Bull service is sold delivered to the dairyman's farm. A patronage agreement is signed by both the bull stud operator and the dairy herd owner.

The plan is not a substitute for Cooperative Bull Associations, but rather supplements them by being more satisfactorily operated among small herds.

Seventy per cent of the cows of the country are in herds of 10 or less, and the average number of cows per herd is less than 6. It is evident that the field for bull studs far exceeds that of herds of suitable size for successful operation of bull associations.

In Idaho bull studs, one bull is mated with three or four times as many cows each year, as are bulls in Idaho Cooperative Bull Associations.

In nine Idaho bull studs are 36 bulls which are breeding annually more than 4000 cows. These Bull Studs are supervised by a committee which meets once each month to audit the records of operation, pass on bull purchases and adjust unsatisfactory management factors.

Higher breeding efficiency is experienced than in Cooperative Bull Associations, possibly due to a douche being administered to the bull immediately following each service. Only one good service per cow and two cows per day are bred by Stud Bulls. Fees range from $3.00 to $4.00 for the initial service per cow, and $1.00 for each return service. Conceptions on the first service averaged 68 per cent during 1937 and about 80 per cent during 1938.

Careful feeding is given the bulls to maintain them in good physical condition and avoid too large barrel or over or under condition.

The plan is more satisfactory to the small herd owner than is a Cooperative Bull Association. The individual herd owner has no investment, is at a minimum of inconvenience, obtains high quality bull service at a cost below that of owning even a scrub bull, no disease spread has been experienced, few complaints manifest, and a constructive breeding program is established.

E3. Extension-Farm Security Bull Associations in Utah. LYMAN H. RICH, Utah State College.

Utah farms are small. More than 30,700 families live on 1,324,000 acres which allows about 43 acres of irrigated land per farm. Twenty-eight per cent of the farms are under 20 acres in size.

The Farm Security Administration has 4,200 individual loans and 4,000 cooperative loans. At least 25 per cent of the farms have a very low income level as indicated by these loans. To meet expenses, unit yields and high unit production is paramount on these farms. Seventy-eight per cent of the farms in Utah have dairy cows, averaging about five in number. Too many

inferior bulls have been maintained for small herds. Reducing the number and improving the quality will raise the much needed farm income.

Cooperative bull blocks and associations have rapidly increased in Utah the past two years to meet this problem of reduced expenses, and marked improvement in quality of herd sires has been made. These bull blocks are supervised cooperatively by the Extension Service and Farm Security Administration. A total of 61 such units have been organized, involving 370 owners and 343 users who sign patronage contracts. These 713 farmers own 3,535 cows cooperating in the plan. Utah farmers live in central towns and villages so that short distances make bull blocks less expensive than other systems. Forty-one of these cooperative blocks have been organized into 13 associations of 3 or 4 blocks each.

These units have their beginning through the need of a loan obtained by a group of farmers through the local Farm Security supervisor, the funds coming from the Farm Security Administration at 3 per cent interest, payable on a five-year plan. These farmers usually have a separate farm loan with the Farm Security and therefore are closely supervised financially. When several blocks in a given area are completely set up, an association is organized. The Extension Service and Farm Security representatives meet all dairymen in these respective groups and consider the constitution and by-laws which have been carefully drafted. Discussion follows relative to quality of herd sires, rotation plan, replacements, insurance, disease control, and other details. Representatives of each block make up the association board, usually five in number. Organization of associations, selection of sires and educational activities are supervised by the Extension Service. The Farm Security assists in organization work and supervises the loans.

Bulls are insured for $100 each through a private company at $7 per year. A fund of $10 per block is set aside for replacement also. Purebred breeders cooperate in furnishing sires with production records at a nominal cost.

Bulls are maintained in suitable pens, 60 feet by 20 feet, minimum size with an open shed dry and free from draft. Service fees range from $1.50 to $2, the number of cows ranging from 40 to 100.

Testing for Bang's disease is a requirement. The loans are paid out in five years' time. This plan has been in operation two years only.

E4. Progress and Prospects of Organized Artificial Insemination of Dairy Cattle. E. J. PERRY, New Jersey College of Agriculture.

According to a questionnaire returned by most of the extension dairymen, 17 cooperative artificial breeding associations with an average of 76 members, 855 cows and 5 bulls were operating in ten states on April 15th, when this was written. The states are: Connecticut, Maine, Missouri, Minnesota, New Jersey, New York, Ohio, Pennsylvania, Tennessee and Wiscon-

sin. Other states reporting associations being formed included California, New Hampshire, Montana, Rhode Island, Vermont and Washington. Interest was reported as developing in several others.

The extension men are practically unanimous in the opinion that cooperative artificial insemination possesses exceptional advantages in dairy cattle breeding. There is general agreement that the three leading ones are these: (1) It makes possible the wide use of outstanding sires, (2) the sires can be proved at a younger age and more effectively than is normally the case, and (3) it also reduces the disease hazard. The principles of genetics can be applied on a wide and practical scale. The survey also revealed an almost unanimous sentiment in favor of veterinarians doing the work for an association. The relation of disease to breeding efficiency renders the services of the veterinarian one of the outstanding features of an artificial breeding program. There are four conditions which need increased attention in dairy herds today. They are: (1) spreading of disease by the bull passing it from one cow to another, (2) diseased semen of the bull, (3) diseased genital organs of the cow and (4) the check-up examination for pregnancy. The losses from any one of these are cutting deep inroads into the profits of the dairymen. These losses can be greatly reduced by a well conducted program of artificial insemination.

The number of inseminations required for those cows becoming pregnant is less than 2 with an approximate average somewhere between 1.7 and 1.8. One association reported 1.3. It is assumed that its herds are predominately Bang's disease free. The yearly charge per cow, covering three inseminations, ranges from $3.00 to $6.00 after the paying of a herd entry fee of $5.00 or $10.00. The bulls are from one to twelve years of age and the difference in fertility even among young ones is reported as being marked.

In most of the associations the members expect a very high rate of conception. This is unfortunate and due to the wide publicity given the project by the press and to the fact that very few know what their conception rate was by natural breeding. A lot of available data indicate that the rate for both methods is running practically the same. It is, therefore, necessary to convince present and prospective members that the new system is not a panacea for the many ills that may befall a herd. Those who have now had experience with the project wish to caution that sires must not be overworked and that at least three and sometimes four are necessary when semen must be taken every day. Plenty of exercise is urged as an aid in keeping the bulls in good condition. Time and labor can be saved in keeping them at a central point regardless of how much the association expands. An association should be organized with care, and only after a healthy demand has come from the dairymen themselves and when outstanding sires and a well trained veterinarian are available.

E5. Utilization of Proved-Sire Records and Herd-Analysis Data. Report of Sire Committee, J. F. KENDRICK, U. S. Bureau of Dairy Industry.

The necessity for the complete utilization of data obtained in the dairy herd-improvement association identification and permanent record program is obvious, if the general program of dairy cattle improvement is to achieve its greatest success. Different methods of utilizing proved-sire and herd-analysis tabulations are used in different states. The Sire Committee shall attempt to bring together all the various methods used and offer recommendations as to those methods which appear to have greatest merit.

In addition to the report on the utilization of DHIA data, the committee shall attempt to bring together in a report those practices followed in the various states to make the Dairy Herd-Improvement Association Identification and Permanent Record Program most effective in the field. Particular attention will be given the various methods employed to encourage the association testers to keep the record work and reports up-to-date.

E6. Utilization on State and County Basis.* WARREN GIFFORD, University of Missouri.

The extensive use of representative herd and sire analyses, presented in chart form, have been used as a demonstration method of teaching the fundamentals of dairy cattle breeding to breeders in county and state meetings.

These analyses have been particularly helpful in dairy cattle breeding schools to illustrate how breeders have used the four systems of mating in successful herd and community breeding plans. Three distinct types of herds have been used, (a) herds periodically outcrossed with beef bulls, (b) high producing herds developed from mediocre foundation grade stock, (c) purebred herds developed by a well planned breeding program. The results obtained give a clear understanding to the underlying principles and technique in the proper evaluation of production records with reference to measuring genetic and environmental factors. They emphasize the value of brood cows and proved sires, the necessity of uniformity in feeding and management practices, the value of a disease control program, continuous testing and permanent identification of all cattle. The material also provides a basis for group discussion on developing breeding plans, available sources of seed stock, data necessary to evaluate breeding animals efficiently and the many other questions involved in the individual and organized community breeding program.

Herd analyses have also been used advantageously in farm breeding plan demonstrations, breed association tours, dairy herd-improvement asso-

* Contribution from the Department of Dairy Husbandry, Missouri Agr. Exp. Sta., Journal Series No. 607.

ciation annual meetings, dairy herd-improvement association membership drives and the county bull book and sire exchange program meetings.

E8. Influence of Disease in Dairy Cattle Breeding Programs. GEORGE E. TAYLOR, New Jersey College of Agriculture.

Disease control problems are of major importance to the breeder of dairy cattle. Failure to control and prevent disease may quickly erase the influence of a lifetime or generations of constructive breeding. The value of an animal for either breeding purposes or economical production is first of all dependent upon the animals' health status. Realization that animals cannot demonstrate their value as desirable breeders or transmitters before 5 years of age or older, emphasizes the great importance of disease control. The control of infectious disease becomes more difficult with advancing age. Attention should be focused on the importance of disease prevention rather than disease treatment.

The service and influence of proven sires is being extended through the sale and exchange of bulls, Cooperative Bull Associations, Community Bull Studs and organized artificial insemination units. Diseases of major importance in bulls, especially proven sires, regardless of program being followed include T. B., Johne's, Bang's, Trichomoniasis and Sterility. In the case of proven dams, mastitis should also be included. Calf scours, colds and pneumonia are the principal causes of death and subsequent loss of valuable blood lines in young animals. Anthrax, Blackleg and Hemorrhagic Septicemia may present a local problem in some sections in addition to other minor ailments.

The importance of herd health and recommended control methods and practices is first of all a problem of education on the part of the breeder. An educational program should include and emphasize the following important points:

1. Relationship between proper feeding and herd health including liberal use of quality roughage.

2. Relationship between management practice and herd health including home grown replacements, size of unit, adequate housing facilities and accurate complete health and breeding records.

3. Complete information concerning specific diseases including: cause, etiology, symptoms, immunity and practical control and preventative measures.

The organization of an integrated and coordinated educational disease control program should include the following agencies cooperating: 1. Extension Service; 2. Experiment Station; 3. State Bureau of Animal Industry; 4. State Veterinary Medical Association; 5. U. S. Department of Agriculture.

The Extension Service should logically take the lead in an educational program including meetings, demonstrations, distribution of bulletins, circulars and mimeographed material with the State Bureau of Animal Industry and the State Veterinary Medical Association cooperating. The function of the Experiment Station and the U. S. Department of Agriculture is fundamentally research concerning disease. The State Bureau of Animal Industry and State Veterinary Medical Association cooperating are responsible for all state and federal health regulations and accreditation of clean disease-free herds. Closer cooperation of the above existing agencies is highly desirable.

E9. Should We Unify the Extension Program? C. L. BLACKMAN, Ohio State University.

Some extension workers have a growing conviction that the agricultural education program should be built more largely around the solution of major farm problems. They place emphasis on the fact that the farm business as a whole is more important than any single enterprise in it. They believe that the solution of many of these problems requires the contribution of more than one department. If this is true it seems to follow that each department involved in the solution of a problem should consult with other departments in order to present a better correlated procedure.

Although it can hardly be said that the different subject-matter departments now plan their programs entirely without regard to the other departments, the question arises, "Is sufficient effort made to relate one subject to another? If not, does the lack of an integrated program of extension education result in each department being less effective than it could be?"

Perhaps the point can best be illustrated by an attempt to meet a serious farm problem in Ohio. According to the records, wheat production during the past 60 years has increased about three bushels per acre, and stands now at 18 bushels. Corn production has remained static at about 37 bushels per acre. The Agronomists point out that improvement in seed and methods of production should have caused a 40 to 60 per cent increase in the per acre production of these crops.

Agronomic investigations indicate that depletion of soil fertility and excessive erosion are chiefly due to unscientific methods of tillage and the growing of too many acres of soil depleting crops such as row crops and small grains and not enough acres of rotation hay and pasture, which are soil building.

Farmers endeavoring to bring their farms into productivity balance found that they were not only faced with the agronomic problems of rearranging their rotation, but as a result of these changes, were faced with the possibility of seriously revising their whole farm program. Dairy farmers were wondering if it was necessary to increase their herds in order to con-

sume the extra hay and pasture which might be produced as a result of cropping changes. At least three departments might make some contribution toward the solution of this problem. (Agronomy, Rural Economics and Dairy Husbandry.)

In the fall of 1937 after conferences with Agents and Specialists in these three departments, it was decided that a series of meetings would be held dealing with each phase of the problem. Each specialist endeavored not only to discuss his particular angle of the problem but also tried to relate his subject-matter to that of the others. The interest in the first series of meetings was so satisfactory that the plan was expanded in 1938 to include the Department of Agricultural Engineering. The meetings were arranged at conferences of agents and specialists. The specialists also met and discussed their different plans of approach and then each specialist prepared an outline of his discussion to be handed to farmers at the time of the meeting. A special effort was made to relate each type of subject-matter material to the others.

This plan is not suggested as the only method of carrying on extension work. Results indicate that it has merit and that its use will help specialists and agents to build a more unified program. The combination and number of departments involved will depend on the natures of the problem.

E10. Michigan Dairy Planning Activities. A. C. Baltzer, Michigan State College.

Endeavoring to develop a long time dairy project in a county with the cooperation of local farmers and dairymen, creamery and dairy processing organizations, educational forces and others will assist the college specialist and the county agricultural agent in establishing a more permanent and a more progressive county and state dairy program.

First of all the local people can choose thoughtfully and wisely if they are given by the specialist the national, the state and the local facts and factors which influence for good or evil their dairy farm business.

For ten years in Michigan such action programs have been emphasized and they have been helpful and fruitful. The local people, dairy farmers and others gain a better vision of the work and the purpose of the college specialist and the county agricultural agent. Our purpose is to develop, create and establish on the majority of Michigan dairy farms a more balanced type of dairy farm operation which will develop permanency and lend improvement to the standard of farm living.

How do we do it? The following projects have been used in Michigan as a means of focusing attention on our aims and we strive to select just one or two activities each year as a feature in the local program. The county dairy planning project serves to head up all the dairy activities in a county when it is practical to use it. From this project a dairy record testing program is

offered which includes the D.H.I.A., H.I.R., and A.R. activity. Closely associated with these production testing programs is the Better Sires project which includes bull surveys, bull clubs and associations, baby bull calf placements, artificial insemination projects, bull pens, college bull lists, conducting breeding schools, district and county bull display days, sire pledging, use of sire proofs, and herd analysis programs. The fourth project is dairy feeding and dairy pasture improvement and management which is encouraged through use of winter schools, winter and summer field and barn tours, creamery and condensery haulers, and elevator men schools, D.H.I.A. summer and winter events, etc. Activities for quality milk and cream are manifold and depend upon the local planning committee's wishes and economic influences. They are closely related with a needful dairy utilization program among farm producers. Cooperation with the state regulatory forces is valuable to explain the sanitary milk and cream laws before county wide meetings. Master butter makers contest, creamery check-up, milk and cream scoring in high schools, annual meetings of creameries, cooperating with district station men and with cream and milk haulers serves to create action by getting processing agencies to install cooling tank service, whitewash service, and assist in distributing dairy products back among producers. Farmers will eat dairy products in great volume and of all kinds if the processing agencies will service the producers. Demonstrations before women home economics groups, P.T.A., etc., are useful, and cooperation with county school commissioners, county medical units, dairy and foods councils in large urban centers are extremely desirable.

It is necessary that the dairy specialist carry through the activity selected, work with the local committee, and next year review the program, report the successes and failures, and counsel with the local leaders further for the ensuing year's effort.

These and other projects which are supplementary when explained before a committee of farmers, dairymen, D.H.I.A. members, processors, urban and rural leaders, will result in their selecting some activity which can be wholesomely conducted in the year to the good of the dairy buisness, to the effective furtherance of the county agents dairy program and add dignity and respect to the state college and the dairy specialist.

E12. Annual Dairy Herd Improvement Association State Reports or Summaries; Their Preparation and Use. ROGER W. MORSE, Oregon State College.

The first dairy herd improvement association was organized in Michigan in 1906. At the present time associations are operating in each of the 48 states and in the islands of Porto Rico and Hawaii. There were 1,228 associations in operation January 1 of this year.

These associations are business organizations of farmers who are organ-

ized into an association and a man hired to keep cost accounts on their cows. The work of dairy herd improvement associations is supervised by the County and State Extension forces and the United States Department of Agriculture.

Since the work was started, in most states there has been an annual audit, report or summary made of the year's work and results by each association. For a good many years, most states have taken these association reports and other information assembled during the year and compiled them into an annual state report and summary of dairy herd improvement association work. These state summaries have been used to give the members, testers, and county agricultural agents in the counties a measure of the scope and results of testing in their counties as compared to other counties of the state. They have been useful as a measure for State Extension dairymen to use in determining progress of their projects.

As this work has developed and grown, the use of testing records has expanded from merely being a basis for culling and feeding, to include compilation of data on breeding practices and on the locating of sires and cows that transmit desirable production and type characteristics to their offspring.

This paper presents a brief outline of the kind of state dairy herd improvement association reports or summaries prepared by the different states. They vary from a single page tabulation of association average production and feed costs to rather elaborate mimeographed or sometimes printed reports and analyses on testing records.

There is a wide variation on the type of information assembled and the uses made of these reports. The relationship of the size of the dairy industry in the different states to the number of Extension dairymen employed, the number of dairy herd improvement associations, and the type and use made of the summaries is discussed.

E13. D. H. I. A. Methods and Results in California. G. E. GORDON, University of California.

Dairy improvement, through cow testing association work, has been carried on in California since 1909. It was not until 1921, however, that the dairy improvement program was organized on a state-wide basis. A study of the situation at that time based upon the 1920 census indicated that average production per cow was not high enough to develop a stabilized and profitable dairy industry. It was found that the industry was of sufficient value to the state to justify efforts to put the industry on a permanent and profitable basis.

In order to do this it seemed desirable to increase the average production per cow of all cows in the state. A state-wide program was, therefore, adopted on a basis whereby a relatively high percentage of dairymen of the state would participate. This program was designed to aid in increasing

average production through culling of low producing cows and through better breeding and feeding practices. All of these improvement practices were, of course, to be based upon production records through rather widely developed testing associations. These associations were to be organized on a basis which would provide sufficient income to keep competent testers interested in the work and still provide the service at reasonable cost to the dairyman. This program was, therefore, based on associations consisting of rather large numbers of cows per unit. This system also eliminated the possibility of testers keeping detailed feed records on the individual cows in members' herds. Furthermore, it seemed desirable that dairymen be encouraged to accept the responsibility for carrying on the detailed feeding program rather than depend upon the testers to do it for them.

In the early years of the program the associations were organized on a yearly basis. This system had certain inherent disadvantages. A change in policy was therefore developed to encourage a longtime point of view toward testing. This policy minimizes the cow testing year as such and emphasizes continued service to members rather than placing emphasis on the securing of new members. Under this plan dairymen are not signed on contract for any specific period of time, but are free to withdraw at any time they desire. The associations accept the responsibility for providing such service in the use of records that dairymen will see the advantages of continued testing.

Experience in our program indicates that success depends upon definite objectives with an organized program to achieve such goals. Any program to achieve widespread results must be widespread in its application. Members of associations must accept certain responsibilities in carrying out the program, rather than having the tester assume those responsibilities for them. Contacts must be maintained with members to insure continued and adequate use of records.

E15. Analysis and Use of D. H. I. A. Feed Records. C. G. CUSHMAN, Clemson Agricultural College.

The more definite and exact evidence agricultural workers can gather which represents the teaching of research data applied to all sorts of differing farm conditions, the more they can divorce themselves from opinionated ideas and the more effective they will be. Of equal importance is putting these facts into visual shape so that they can be easily seen.

There is latent in the great mass of D. H. I. A. feeding records, facts of unusual character which can be turned into powerful working tools that will set dairy specialists upon the solid rock of "facts" as he deals with varying and sometimes puzzling sets of circumstances.

The feed cost of milk production represents from 60 to 70 per cent of the total cost. The dairy farmer may quickly influence this 60 or 70 per cent of his total cost by herd and farm management.

The most elementary analysis of feed records is the grouping of herds according to practice based on information in testers monthly reports. Such grouping in South Carolina in February 1938 on the basis of annual grazing versus no grazing showed $4.03 per cow greater return over feed cost and 45 cents per 100 pounds saving in feed cost in favor of annual grazing. In February, 1937, two herds are compared in the months of December, January, and February, one having adequate annual grazing and the other insufficient annual grazing, other conditions being similar, to show a striking difference in favor of abundant annual grazing.

Heavy grain feeding *versus* moderate grain feeding according to the October 1937 monthly report showed a gradation downward trend from a feed cost of $1.80 per 100 pounds to $1.08 per 100 pounds.

An analysis of June through November reports on one herd show 33.2 tons of hay equivalent grazed from 12 acres of kudzu by 35 cows.

The December 1938 monthly report showed substantial evidence of lowered cost and higher milk yield in favor of herds fed on a program of all silage and no hay with grain as compared to herds feeding silage plus other roughage and grain.

Herd analysis charts are prepared showing a year's picture by months of the behavior of herds as to feed requirements, feed fed, average milk per milking cow, average milk all cows (including dry), and feed cost per 100 pounds milk. Statistical and chart analyses on two herds are shown.

All cows on test in 1937 are grouped according to type of market and a study made of the source of feed nutrients. Analysis shows that high or low prevailing price of dairy products indicates a feed production program which should furnish nutrients in either the cheaper or the more costly feed sources. This analysis is set forth in several tables which correlate sources of feed nutrients with price of milk in different types of market.

E16. Progress of Demonstrations with Grass and Legume Silage.
DWIGHT M. SEATH AND JAMES W. LINN, Kansas State College.

Field reports indicate a growing interest in acid and molasses-treated silages. These special treatments which permit the preservation as silage of the legume and grass crops are now being adopted by widely-scattered dairymen even though they are hardly out of the experimental stage. Field workers in dairying need more information pertaining to the practicability of such treatments as well as the best methods to advocate in their use. They also need to know the relative merits of the methods as well as conditions under which each method should be recommended. Comparative results based on demonstrations within the various states will do much to supplement information gained from experimental work as a guide for future recommendations.

There are many reasons advanced for the growing interest in grass and

legume silage. For certain dairymen, this method of feed preservation offers a solution for the better utilization of the first crop of legume hay which otherwise is often damaged by rain. Some have the same object in mind but use the cereal grains, such as oats, for the silage crop. Others provide mid-summer pasture from the silo by the preservation of a high-protein legume or cereal crop in the spring and feeding it in July and August, thus maintaining production and keeping up the quality of the milk produced. Still others use the acid or molasses method of preservation solely as a means of fortifying their milk with carotene, thus permitting the production of spring-colored milk throughout the year. A combination of these reasons plus others not mentioned motivate many to use these special silages.

Practical objections to these special silages include the cost of the various preservations, the labor and inconvenience of treating silage materials, the variation in the palatability of the silage depending upon the maturity of the crop or the amount of preservative used, and the labor and lack of machinery for conveniently handling the green forage material. With more experience, dairymen will devise and standardize methods which will eliminate many of the existing objections.

The results of a survey made of Kansas dairymen who have been using either the acid or the molasses method of treating silage crops will be a part of the complete report given on this subject.

E17. Pasture Improvement as a Project in the State Dairy Extension Program. O. J. HILL, State College of Washington.

Pasture improvement has been carried out as a cooperative project with the Soils and Crops specialist. Due to a great diversity of conditions no one program is adaptable to all parts of the state. In order to develop interest in grasses best adapted to different regions, rod row plantings have been used extensively.

Permanent plantings are encouraged wherever feasible. Cooperators are selected to seed approved mixtures according to best agronomic practice. Tours are conducted to these demonstration plantings during the grazing season. Some demonstration plantings have been in for 18 years.

Carrying capacity studies on dairy farms have been made; however measurable results are difficult to secure due to varying stands of grass and methods available for collecting data. Permanent pastures on good bottom land at the Western Washington Experiment Station have produced 5498 pounds of digestible nutrients per acre. This is more nutrient than can be grown with other crops in this area. Carrying capacity has been increased to 5985 pounds following rotational grazing.

Farms that have developed adequate permanent pasture to meet their requirements during the dry season usually have a surplus of forage during April and May. Certain plots are not grazed at this time and are cut at an

early stage of growth for silage. This silage has been preserved either in stacks or in tower silos.

Pasture fertilization has been a definite part of this program. In order to emphasize the importance of manure in pasture fertilization, some demonstrations on good manure storage systems are used each year. Special emphasis has been placed on the use of liquid manure. Phosphate fertilizers are valuable in most cases to supplement either liquid or solid manure.

Other management practices emphasized are: harrowing, clipping, reseeding, and danger of overgrazing.

E18. Report of Quality Improvement Committee. C. J. Babcock, *Chairman,* U. S. Bureau of Dairy Industry.

The committee recognizes the fact that milk and cream sold for fluid consumption, with the exception of that in some of our smaller communities, is of good quality. We also recognize the fact that a large quantity of milk entering into the manufacture of dairy products is not of a satisfactory sanitary quality; and that improving the quality of such milk and cream is not only an extension problem, but one that is not receiving proper consideration.

Extension projects have been outlined for improving the quality of milk and cream. Many of these have been criticized on the basis that they were too complicated and involved too much time. It is the opinion of this committee, however, that in order for extension workers to accomplish worthwhile quality-improvement work they must first have a well-planned project and a definite goal in view.

B. F. Whitmore, dairy extension specialist of Illinois, has been operating an area plan of quality improvement for the past 18 months. The plan is similar to that advocated by your quality committee for the past 2 years. During this time a marked improvement in the quality of milk sold for all purposes has been accomplished. There has been a marked decrease in the quantity of Grade C milk and a marked increase in the quantity of Grade A milk produced, the grades being based on the methylene blue reduction test.

E19. Growth of Pennsylvania 4-H Club Calves. Joe Nageotte, Pennsylvania State College.

Our dairy club members join a calf club to start a herd of purebred cattle and to learn how to care for a purebred herd. To reach this goal they need close supervision by the dairy extension specialist. The result of this supervision is a result demonstration on growing heifers. These demonstrations by club members have been one of our best methods to introduce improved practices in dairy herds. We dairymen have also learned from the club members what can be done and what cannot be done on farms. From this knowledge has evolved a method for growing out calves that may be of value.

Most members secure calves from 3 to 8 months old. They are fed hay, water, and a grain mixture containing 16 per cent protein and one teaspoon of cod liver oil a day. They are fed as much grain as they need to keep them in good growing condition until they are about 16 months old. Grain required varies from 2 to 8 pounds per day. The calves are not pastured their first summer and are not fed silage their first winter. At about 16 months of age the heifers are bred and then fed only roughage of hay and silage in winter or pasture in summer.

This method of feeding brings about a very rapid growth while the heifers are young. Where the schedule has been followed closely the heifers have shown the heart girth and height of withers of heifers several months older as shown by the standard rate of growth chart of Ragsdale, et al.

Figures have been collected from two clubs and will be presented by chart or slides.

E20. The Contribution of 4H Dairy Clubs to the General Dairy Extension Program. J. O. TRETSVEN, Montana State College.

One of the most important features of the Smith-Lever act provides for a system of itinerant teaching for farm boys and girls. It is a well recognized fact in teaching principles that a general educational program, as provided for by the Smith-Lever act is most effective by working with the farm youth. Every county agent who has had several years of experience in working with farm folks well knows the wisdom of this policy. The 4H Dairy clubs have contributed in many ways to the general dairy extension program.

1. The 4H Dairy clubs have in many cases been a means of getting adults interested in agricultural extension work. Parents who have been indifferent to or opposed to the work of county agents have become staunch supporters of the extension service through their son or daughter becoming a 4H Club member and in turn the parents have been greatly benefited by the service.

2. The instructions offered through the 4H dairy projects have not only resulted in developing the boys and girls to become more efficient in selecting, feeding and caring for their animals, but it has been a means of teaching better dairy practices in the community. The 4H dairy demonstration teams have taught, in a most effective manner, by actual demonstrations many valuable lessons on important phases of dairying.

3. The organization of dairy clubs have in many instances been instrumental in bringing into the community high class animals which in turn has been a big factor in the improvement of the cattle locally.

4. The training and experience offered the 4H Club members have created an interest in improving dairy cattle and a desire to go into the dairy business on a higher plane. In later years many of these 4H Club members

have developed into breeders of purebred cattle and in turn have been a source of good breeding stock in the community.

5. The 4H Dairy Club members learn the principle of cooperation in both work and play. A well organized dairy club may, through their own organization, be instrumental in uniting the dairy farmers of a community into essential cooperative organizations. Many former 4H Club members are, today the principal community leaders in their county.

No dairy extension program will be complete without a strong 4H Club program.

PAPER READ BY TITLE

———. **The Relation of the Posterior Hypophysis in the Maintenance of Lactation in Hypophysectomized Rats.** E. T. Gomez, U. S. Bureau of Dairy Industry.

Lactation which normally ceases immediately following complete hypophysectomy of lactating rats was maintained for periods ranging from 7 to 10 days by the simultaneous daily injections, beginning immediately after the operation, of adrenal cortical extract (eschatin), glucose solution and an aqueous suspension of anterior pituitary powder of proven lactogenic activity. The young of such animals, however, succumbed in 2 to 3 days, apparently of starvation, in spite of the fact that they suckled their mother's breast almost constantly and milk was present in quantities in the mammary glands. Successive litters introduced to hypophysectomized lactating rats immediately after the death of their own young likewise succumbed after a few days. Frequent inspections and autopsy of the young revealed complete absence of milk from the digestive tract.

Injections of posterior lobe extract (pituitrin) along with the daily "lactation maintaining" therapy of hypophysectomized rats permitted the young to get the milk from the mammary glands. By these treatments the period of the maintenance of lactation was extended for periods of over 28 days. Withdrawal of pituitrin from the daily therapy at any time during the course of the experiment was immediately followed by a rapid loss of body weight of the young terminating in death unless pituitrin injections were promptly resumed.

The average body weight of young reared by hypophysectomized rats was significantly less than that of young reared by control animals, including lactating rats subjected to sham operation, normals or those rats kept on limited daily food intake equivalent to that of hypophysectomized lactating rats. The average daily food intake of hypophysectomized rats was approximately 50 to 60 per cent below those of normals.

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The leadership of Mixevan for quality is the result of over 30 years specialized experience. Its uniform character is achieved through expert knowledge, individual selection of beans, extra development of the bouquet, intricate compounding and special grinding technique . . . *It is the ultimate in fine flavoring for dairy products.*

MICHAEL'S MIXEVAN
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MADE FROM BOURBON AND MEXICAN VANILLA BEAN, VANILLIN AND SUGAR
EXPERTLY BLENDED AND PROCESSED TO PRODUCE A DELIGHTFUL MELLOW MILD FLAVOR
DAVID MICHAEL & CO.
VANILLA PRODUCTS
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BACTERIOLOGICAL METHODS FOR THE ANALYSIS OF DAIRY PRODUCTS

A 10-page reprint (with cover) from the October, 1935, *Journal of Dairy Science*. Prepared by Subcommittee on Bacteriological Methods for the Analysis of Condensed and Evaporated Milk and Committee on Bacteriological Methods for the Analysis of Milk and Dairy Products.

and

METHODS OF ANALYZING DAIRY PRODUCTS

Second Edition

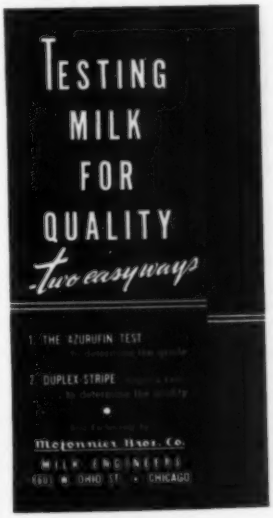
Consisting of 29 pages (also with cover) reprinted from the *Journal of Dairy Science*, May, 1933. Originally sold for 50 cents.

Both of these are now being offered at 40 cents, for the combined butter and ice cream report and the concentrated milk report.

Many schools are using these reports in their class work. They are up-to-date and will be found most useful for students.

These may be ordered through the Secretary's Office. Address—R. B. Stoltz, Ohio State University, Columbus, Ohio.

A *New* Dairy Service



Scientifically accurate Quality and Acidity tests of milk and cream.

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The complete story is contained in this new booklet JUST OFF THE PRESS! Send for your copy TODAY.

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RENNET *and* COLOR

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are uniformly strong and pure, hence always dependable. Up-to-date methods and exact control of production insure the quality of Marschall's.

Liberal samples of Marschall preparations for class work or experiment may be had for the asking.

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FLAV-O-LAC FLAKES produce a quart of the finest starter **on a single propagation. Single bottles $2.00.**
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Our cultures are safely shipped to all parts of the world on a guaranteed, money-back basis. Send for free informative booklet on the use of cultures in fermented milk products. It covers 25 years of research.

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See our Catalog in Dairy Industries Catalog

COLON BACILLI IN MILK AND WATER

BBL-Desoxycholate Lactose Broth
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These media offer the most uniformly reliable and economical means for the enumeration of colon bacilli. The advantage of these media over most others lies in the use of Sodium Desoxycholate as sole bacteriostatic agent. Sodium Desoxycholate is a pure chemical and has a clear-cut inhibiting effect on the growth of Gram positive bacteria as compared to Gram negative bacteria. It thus has none of the disadvantages generally found in other bacteriostatic agents such as bile, bile salt mixtures, or dyes.

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MORTENSEN POSITIVE AUTOMATIC SYSTEM OF PASTEURIZATION

A totally enclosed continuous flow method of Pasteurising milk that meets the requirements of all Health regulations. The holding period is accurately governed by positive automatic gears that cannot be changed. Milk must be held for a minimum of 30 minutes or dumped on the floor.

With either the JUNIOR unit, for plants of small or medium capacities, or the larger unit for plants of large capacities, the milk is not in view from the time it enters the weigh tank until it appears in the bottle. There can be no plant contamination during the processing period.

Made in capacities of from 2,500 to 30,000 pounds per hour in tinned copper or stainless steel and priced as low as is consistent with dependable machinery.

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LOUISVILLE KENTUCKY

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Concerning

FRO-DEX

FRO-DEX* was originally conceived and developed specifically for use in ice cream, sherbets, and water ices, and was first introduced to the trade last October at the Dairy Industries Exposition. The immediate interest and the rapid adoption of FRO-DEX by many manufacturers have well demonstrated that the original plans and subsequent research were correct for producing a product (FRO-DEX) with a number of new and useful properties.

What is FRO-DEX?

FRO-DEX is a combination of pure cereal carbohydrates; namely, maltose, dextrins (pro-sugars), and dextrose, simultaneously produced from American corn.

Advantages of using FRO-DEX.

Because certain of the constituents of FRO-DEX have a higher molecular weight than the sugars commonly employed in ice cream production, FRO-DEX causes less freezing point depression and a quicker freeze is therefore possible.

The unusual combination of sugars resulting in FRO-DEX retards lactose precipitation and assures a resulting product of smooth texture and firm body.

Ice cream produced with FRO-DEX as an ingredient holds up much better in storage and dealers' cabinets. Sherbets and ices made with FRO-DEX do not separate syrup or crust over in storage or dispensing cabinets. Such interesting results are readily observed and are likewise easily understood when the physical properties of this unusual combination of sugars (FRO-DEX) are reviewed.

Due to its mellowing effect on ice cream, FRO-DEX enhances the true cream flavor of the dairy ingredients but at the same time contributes no flavor to the finished product.

Total solids can be increased economically and without the disadvantages of previously known methods.

How is FRO-DEX used?

Varying combinations of FRO-DEX and cane sugar are recommended, depending upon the type of resulting product desired.

We would be very glad to have you try FRO-DEX and to send you additional information. Address the Technical Service Division.

AMAIZO

AMERICAN MAIZE-PRODUCTS COMPANY

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"Of all the common foods available, milk is most suitable as a carrier of added vitamin D. Vitamin D is concerned with the utilization of calcium and phosphorus, of which milk is an excellent source. The Council has recently made the decision that for the present milk is the only common food which will be considered for acceptance when fortified with vitamin D."

Council on Foods decision,
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• With this statement, the Council on Foods—representing the consensus of organized medicine's nutritional opinion—helped to establish another opportunity for public health service by the milk industry.

• The opportunity to play a major role in public health progress always has been welcomed and proved profitable by the milk industry. The vitamin D milk project—sponsored by the industry and recognized by organized medicine—is merely a logical follower of other public health efforts, pasteurization, tuberculin testing, et al.

• Vitex—the actual vitamin D of cod liver oil—is available to and used by dairymen who believe that opportunities for legitimate self-advancement lie in meeting a proven human need.

VITEX LABORATORIES, INC.

Producers of Vitex for the Vitamin D fortification of Milk

A **NOPCO** *Subsidiary* • **Harrison, N. J.**

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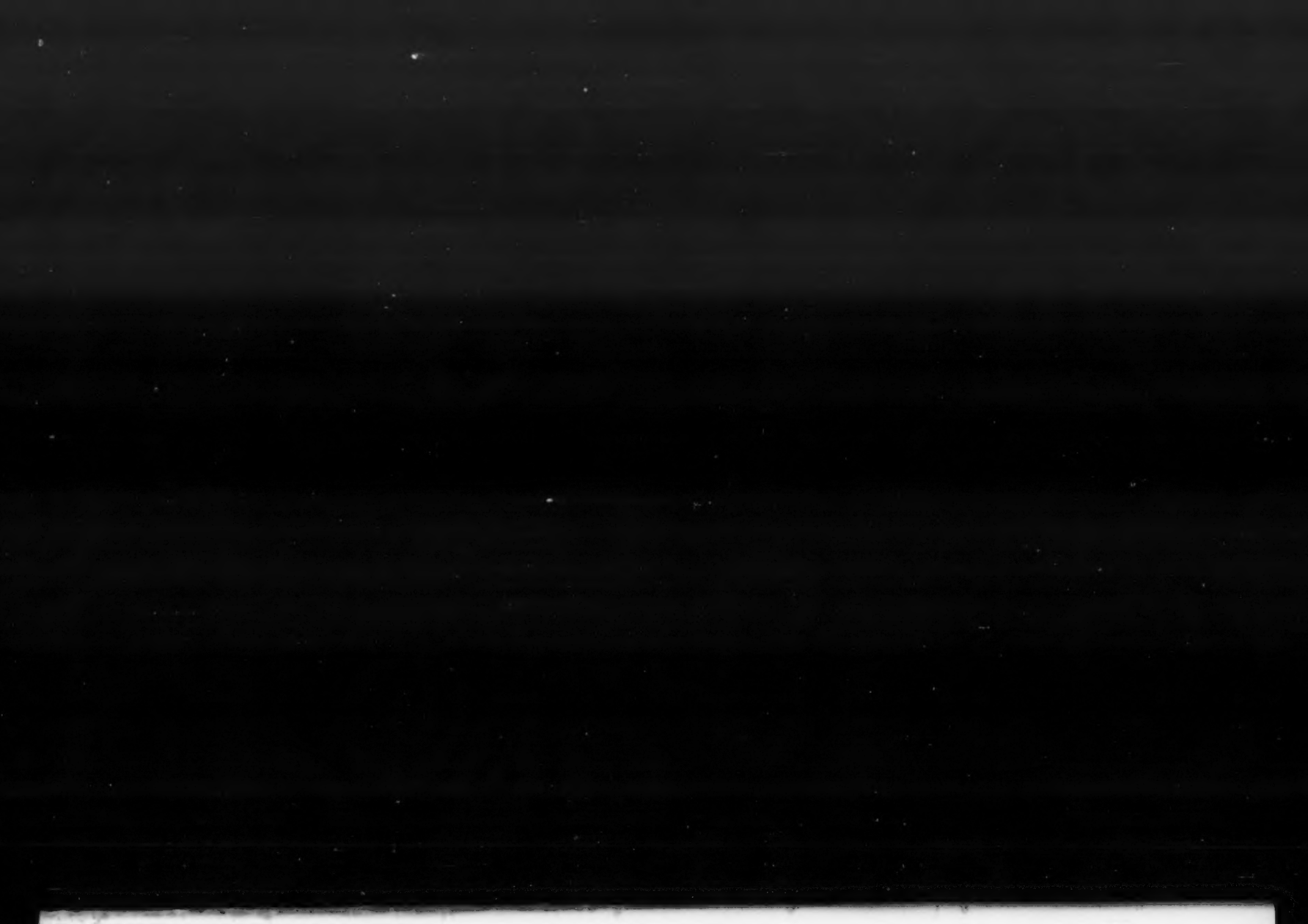
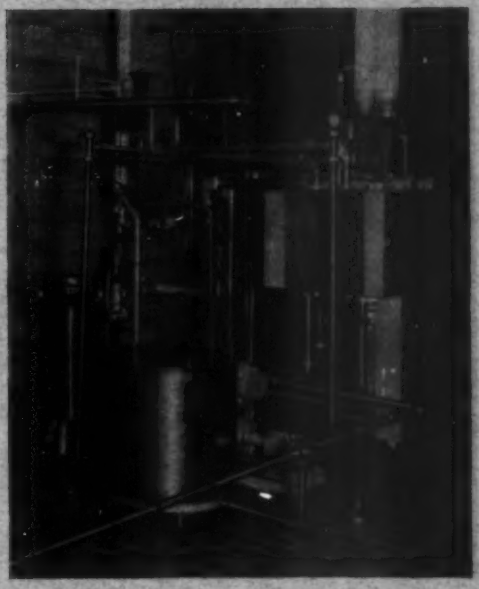


Advantages of CP *Full-Flo* PLATE EQUIPMENT

● Its original double port Full-Flo Plates give maximum efficiency for heating, cooling and short time, high temperature pasteurization . . . have a distinct bearing on the quality of the product being handled, sanitation and operating economy. Free-venting as well as free-draining CP Plates reduce the possibility of adhesion of solids . . . minimizing the milkstone problem . . . insuring optimum bacterial distruction. Savings in heating and cooling as high as 75 to 80% are possible when regeneration is used. Cleaning can be accomplished in one-third of the time it takes to clean a surface cooler; and in less than one-half the time it takes to clean an internal tube cooler. Outstanding among many other important advantages are:



This Cp Full-Flo Unit, used for short time pasteurization in a prominent mid-Western dairy plant, was originally set up for 6,000 lbs. per hour; then increased to 8,000 lbs. simply by adding plates and increasing length of Holder Tube.

(1) Versatility; (2) Quick Change Over; (3) Long Life and (4) Compactness. A heating-cooling and regenerating unit of 12,000 lbs. hourly capacity measures but 42″ wide by 72″ overall in length and 64″ in height.

For full details on the distinctive diamond pattern of CP Full-Flo Plates and other outstanding construction and operating advantages, write for Bulletin E-5.

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BACTO-TRYPTONE GLUCOSE EXTRACT AGAR

(for "Standard" Plate Counts of Milk)

THE new edition of "Standard Methods for the Examination of Dairy Products" of the American Public Health Association specifies the use of tryptone glucose extract agar for determining plate counts of bacteria in milk. The use of this new medium becomes effective July 1, 1939.

BACTO-TRYPTONE GLUCOSE EXTRACT AGAR is now available to all dairy bacteriologists and public health laboratory workers in order that they may follow "Standard Methods" producers.

BACTO-TRYPTONE GLUCOSE EXTRACT AGAR is prepared from approved and standardized ingredients in accordance with the specifications of the new official formula. When it is made up for use it corresponds exactly with the medium approved in the new "Standard Methods." It requires no filtration and it has a reaction of pH 7.0 after autoclave sterilization. Colonies developing upon this medium are larger and are more representative of the bacteria encountered in milk than those secured upon the nutrient agar previously used for milk counts.

BACTO-TRYPTONE GLUCOSE EXTRACT AGAR is available in one pound, one-quarter pound and twenty-four gram bottles. The twenty-four gram quantity is sufficient for one liter of medium and the one pound bottle will yield eighteen liters.

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